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THE SOCIETY is the growth of over forty years of achievement and leadership. Its members are engineers and technicians skilled in every branch of motion-picture film production and use, in television, and in the many related arts and sciences. Through the Society they are able to contribute effectively to the technical advance of their industry. The Society was founded in 1916 as the Society of Motion Picture Engineers and was renamed in 1950.

Membership in Sustaining, Active, Associate or Student grades is open to any interested person according to his qualifications. Information about membership, technical activities and standards and test films for the industry is available from Society Headquarters.

SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

Headquarters Office: 55 West 42d St., New York 36, N.Y. Cables: Somopict Telephone: LOngacre 5-0172

Executive Secretary: CHARLES S. STODTER

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One Convention vs. Two Conventions a Year

An Open Letter to Members

THE GROWTH and development of the Society, the diversity and widening applications of motion-picture and television engineering, the effectiveness of equipment exhibits in recent years, and the general state of business activity are factors which now compel an evaluation of the Society's convention policies. The question has been raised not only as a normal policy question by the Convention Vice-President making his report to the Board of Governors, but also by various individual and sustaining members and by the equipment exhibitors who now participate in our convention activities.

The Board of Governors has agreed that a committee should be established to examine this question and make a policy recommendation.

As a result of discussions with the other officers of the Society, I have asked a former President, Loren Ryder, to become the Chairman of a Convention Planning Committee which will consist of:

Loren Ryder, *Chairman*
Herbert Barnett
G. Carleton Hunt
Keith B. Lewis
Reid H. Ray
Sidney P. Solow
Malcolm G. Townsley

Thus, this committee will have the services of two former Presidents, a current Vice-President, and other prominent and experienced members. Representation is provided from Hollywood, Chicago, Washington and New York Sections so that a reasonably broad geographic coverage is assured.

The committee also proposes to draw on Denis Courtney of the Society's headquarters staff for contact with the equipment exhibitors, since Denis is now cooperating with a committee of these exhibitors, formed at the 81st Convention to help in planning future equipment exhibits. Reid Ray will assist the committee in contacts with the Society's Sustaining Members since he is also the chairman of the Sustaining Membership Committee. Carl Hunt, as our Convention Vice-President, will be able to provide the committee with much information on convention planning up to this time.

Before detailing the basic factors involved in this study, it should be clearly understood that present Society plans for future conventions cover the period of the next four years, and that it is not likely that significant changes could be made very soon.

Here are some of the facets of this knotty problem:

(1) In the past, two conventions were generally needed to provide sufficient papers for the *Journal*. Recent experience indicates that this is no longer absolutely necessary.

(2) Whereas equipment exhibits may once have been optional, it is now our experience that desirable hotels insist on such substantial payment for public space (one to six thousand dollars), that an equipment exhibit is financially necessary. Also, exhibits serve the purpose, like advertising in the *Journal*, of bringing much information on new equipment and services to the engineers attending a convention. Some exhibitors, however, may prefer to exhibit only once a year. The recently formed Exhibitors' Committee is approaching this problem in an open-minded and constructive manner.

(3) Engineering Committees, with some exceptions, hold their meetings at the semiannual conventions. Members from farflung parts of the United States and Canada have less difficulty planning to travel to a convention than they would to committee meetings at other times; holding only one convention could cause considerable problems in the engineering activities.

(4) It is quite possible that holding only one convention a year might require more concurrent paper sessions. On the other hand, it might be the ideal way to stimulate one- and two-day Section Meetings from which papers could be drawn for the *Journal*. In this respect, the Chicago Section has pointed the way very successfully these last two years.

(5) The Society has hotel commitments that range ahead about four years. (See the inside back cover of this *Journal* for the Conventions scheduled.) We would have to be careful to indicate that a planned change would not likely take place very soon. It may also be that if a change is undertaken, it would be on the basis of a test program so that we would be free to go back to two conventions a year if that proved desirable.

(6) Comparing our Society with others does not readily yield practical guidance. We are more diversified in general and our geographic area interests are quite varied. Our publications program is not as flexible as those of larger societies which have two or three types of periodicals and membership services. Our financial resources are modest enough to require constant caution.

(7) There are additional problems, such as: How do we honor the new Canadian Section except by holding one meeting in Toronto? What about the scheduling of such as the Society's 85th Convention which includes the International Equipment Exhibit planned for Miami in 1959? Or the 1960 Washington meeting at which we will be the State Department's hosts for the 5th International High-Speed Congress? How do we "work in" the resort conventions? Also, last but certainly not least, how do we resolve the problem of sufficient convention service to meet the reasonable requirements of the large blocks of membership who reside in various areas, especially East and West Coasts and the Midwest?

It is hoped that this discussion has served to acquaint the general membership with the "charge" that has been entrusted to the newly appointed committee. It is recognized that the problem is neither simple nor one which can be resolved in a great hurry.

It is very possible that various surveys of the membership will be required to supply the committee with necessary factual information. With the idea in mind that the Society should continue to be managed for the benefit of the membership as a whole, it is hoped that you will cooperate fully if you are approached for information as part of any survey which may be undertaken. Chiefly by such means can your reactions, constructive criticisms, and helpful suggestions be interpreted to guide the Society's future conduct in connection with convention planning.

July 1, 1957

Barton Kreuzer
SMPTE President

Noise-Level Reductions of Barriers

By MICHAEL RETTINGER

The paper discusses the sound-level reductions of barriers such as solid walls and fences interposed between the source of noise and the point of observation. The formulas for the calculations are obtained from the optical case in which light is directed against a knife-edge and the light intensity is measured in the shadow (penumbra). The article contains curves showing the sound-level reduction as a function of frequency and wall height for constant distance from source to wall and from wall to observer, as well as curves showing level reduction at 100 cycles as a function of wall height and distance between noise source and wall, while the observation distance is kept constant.

NEWSPAPERS and magazines frequently recommend the use of walls and hedges near noisy freeways and airplane landing fields for the purpose of reducing the transmission of unwanted sound into residential areas. In spite of these rather widespread suggestions, remarkably little data — theoretical or empiric — exist on the subject.* Yet, with quiet surroundings at a premium these days, and with noise steadily increasing, the matter deserves consideration, particularly for motion-picture studio lots. What can be expected of, say, a 20-ft high concrete wall near a main traffic artery or airport, in the way of cutting down the disturbing traffic rumble? Or, we may ask, how high does such a barrier have to be to become effective? How far or how near does the source of sound on one side of the wall and the observer on the other side of it have to be to provide desired results for a given height of wall? Are all sound frequencies equally affected by an obstruction, or is there frequency discrimination? These are some of the questions which are asked, almost daily, and which the writer will try to answer.

As mentioned previously, textbooks on acoustics (the author's own included) are practically devoid on the subject. Fortunately we have recourse in an optical case — the well-known diffraction problem of light distribution when radiant energy strikes a knife-edge. The analogy is perfectly valid because both instances are pure wave phenomena.

Unfortunately, the calculations do not lend themselves readily to exposition. The reason for it lies in that the computations involve so-called Fresnel Integrals. There is nothing mysterious about them, however; they are just functions like sines and cosines, and a table of them will be found in the Appendix to this paper.

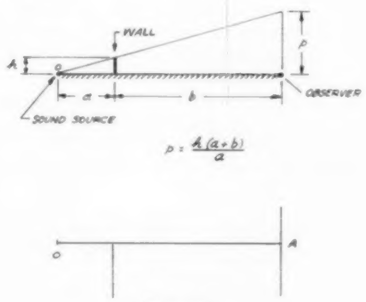

Figure 1

The fundamental equation underlying the sound-level reduction of barriers, in decibels, is:

$$\text{S.L.R.} = -3 + 10 \log \left[\left(\tfrac{1}{2} - x\right)^2 + \left(\tfrac{1}{2} - y\right)^2\right]$$

To obtain x and y, as given in the aforementioned table, we must first determine a value v, given by:

$$v = p\sqrt{\frac{2a}{\lambda b(a+b)}}$$

where λ is the wavelength of sound in which we are interested, and where a, b and p are the dimensions shown in Fig. 1. Note that both the source of sound and the observer are assumed to be stationed on the ground. If both source and observer are, say, 4 ft above

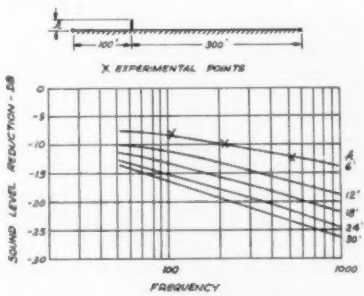

Figure 2

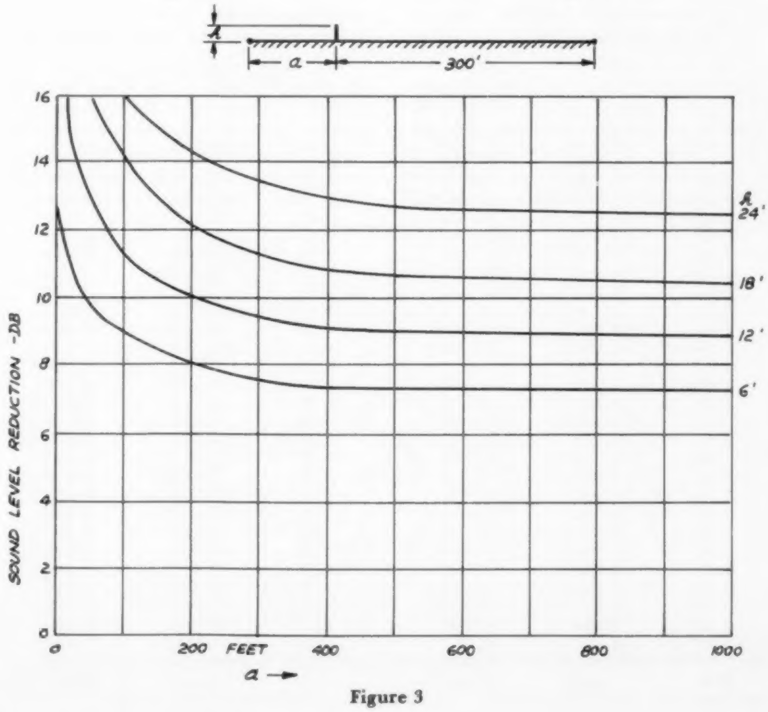

Figure 3

Presented on May 3, 1957, at the Society's Convention at Washington, D. C., by Edward P. Ancona, Jr., for the author, Michael Rettinger, Engineering Dept., Commercial Electronics Products, Radio Corp. of America, 1560 N. Vine St., Hollywood 28.

(This paper was received on April 8, 1957.)

* A paper by R. O. Fehr entitled "The Reduction of Industrial Machine Noise," presented at the *1951 Noise Abatement Symposium* contains information on the subject, but the paper was never published. While the writer is not familiar with Fehr's paper, he believes that it differs widely from his own, both in scope and method.

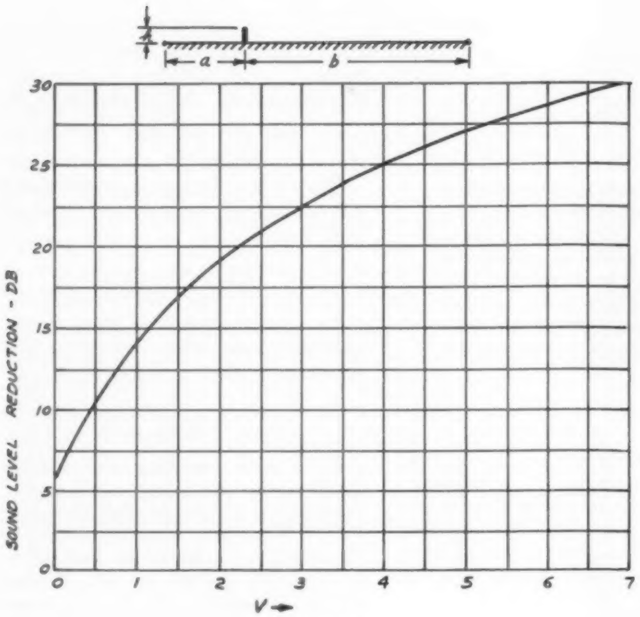

Figure 4

the ground, the wall height used in the computations has to be 4 ft smaller. In terms of the wall height, h, the above equation may be written as:

$$v = \frac{h(a+b)}{a}\sqrt{\frac{2a}{\lambda b(a+b)}}$$

$$= h\sqrt{\frac{2(a+b)}{\lambda ab}} = \frac{1.414h}{\sqrt{\lambda}}\sqrt{\frac{a+b}{ab}}$$

where, again, the values of a and b are those shown in Fig. 1.

Let us consider a numerical example. Assume $a = 100$ ft, $b = 300$ ft, $h = 6$ ft, $\lambda = 11.3$ ft (100 cycles), then:

$$v = \frac{1.414 \times 6}{\sqrt{11.3}}\sqrt{\frac{100+300}{100 \times 300}}$$

$$= 0.29$$

From the Fresnel Integral Table we obtain, if $v = 0.29$, $x = 0.299$, and $y = 0.014$. Then:

$$\text{S.L.R.} = -3 + 10 \log [(0.5 - 0.29)^2 + (0.5 - 0.014)^2]$$

$$= 8.5 \text{ db}$$

What does this figure mean? It means that, at 100 cycles, the sound-level reduction offered by a 6-ft high wall (with both source of sound and observer stationed on the ground) will be 8.5 db. In other words, the level measured at 400 ft from the source would be 8.5 db higher if the wall were not there.

Figure 2 shows the sound-level reduction for walls of various heights as a function of frequency for the case discussed above ($a = 100$ ft, $b = 300$ ft).

Figure 3 shows sound-level reduction figures for the case in which distance b remains constant, while a varies from a small value to 1000 ft. The curves pertain to a frequency of 100 cycles and were calculated for various wall heights.

What conclusions can we reach from these calculations? Speaking very broadly we may say that for most cases of economical wall or barrier construction, a noise-level reduction of about 10 to 15 db will result. This is true, of course, only as long as the source remains at the height assumed in the calculation. In the case where an airplane takes off, the noise-level reduction is practically nil once the plane's altitude exceeds wall height. On the other hand, a noise-level reduction of 10 db may have a pronounced psychological effect. The writer measured the noise-level reduction of a 6-ft high privet hedge once which fronts his property. While the measured reduction was only 3 db, some visitors claim that the hedge "cuts down the noise in half." Of course, a 10-db level reduction at 100 cycles corresponds to almost 20 db (phones) reduction in loudness, according to the well-known Fletcher-Munson curves.

It should be noted that the figures given above correspond to the sound-level reduction of walls, compared to sound-level measurements made in the absence of such walls. They do not

Table of Fresnel Integrals

v	x	y	v	x	y	v	x	y
0.00	0.0000	0.0000	3.00	0.6058	0.4963	5.50	0.4784	0.5537
0.10	0.1000	0.0005	3.10	0.5616	0.5818	5.55	0.4456	0.5181
0.20	0.1999	0.0042	3.20	0.4664	0.5933	5.60	0.4517	0.4700
0.30	0.2994	0.0141	3.30	0.4058	0.5192	5.65	0.4926	0.4441
0.40	0.3975	0.0334	3.40	0.4385	0.4296	5.70	0.5385	0.4595
0.50	0.4923	0.0647	3.50	0.5326	0.4152	5.75	0.5551	0.5049
0.60	0.5811	0.1105	3.60	0.5880	0.4923	5.80	0.5298	0.5461
0.70	0.6597	0.1721	3.70	0.5420	0.5750	5.85	0.4819	0.5513
0.80	0.7230	0.2493	3.80	0.4481	0.5656	5.90	0.4486	0.5163
0.90	0.7648	0.3398	3.90	0.4223	0.4752	5.95	0.4566	0.4688
1.00	0.7799	0.4383	4.00	0.4984	0.4204	6.00	0.4995	0.4470
1.10	0.7638	0.5365	4.10	0.5738	0.4758	6.05	0.5424	0.4689
1.20	0.7154	0.6234	4.20	0.5418	0.5633	6.10	0.5495	0.5165
1.30	0.6386	0.6863	4.30	0.4494	0.5540	6.15	0.5146	0.5496
1.40	0.5431	0.7135	4.40	0.4383	0.4622	6.20	0.4676	0.5398
1.50	0.4453	0.6975	4.50	0.5261	0.4342	6.25	0.4493	0.4954
1.60	0.3655	0.6389	4.60	0.5673	0.5162	6.30	0.4760	0.4555
1.70	0.3238	0.5492	4.70	0.4914	0.5672	6.35	0.5240	0.4560
1.80	0.3336	0.4508	4.80	0.4338	0.4968	6.40	0.5496	0.4965
1.90	0.3944	0.3734	4.90	0.5002	0.4350	6.45	0.5292	0.5398
2.00	0.4882	0.3434	5.00	0.5637	0.4992	6.50	0.4816	0.5454
2.10	0.5815	0.3743	5.05	0.5450	0.5442	6.55	0.4520	0.5078
2.20	0.6363	0.4557	5.10	0.4998	0.5624	6.60	0.4690	0.4631
2.30	0.6266	0.5531	5.15	0.4553	0.5427	6.65	0.5161	0.4549
2.40	0.5550	0.6197	5.20	0.4389	0.4969	6.70	0.5467	0.4915
2.50	0.4574	0.6192	5.25	0.4610	0.4536	6.75	0.5302	0.5362
2.60	0.3890	0.5500	5.30	0.5078	0.4405	6.80	0.4831	0.5436
2.70	0.3925	0.4529	5.35	0.5490	0.4662	6.85	0.4539	0.5060
2.80	0.4675	0.3915	5.40	0.5573	0.5140	6.90	0.4732	0.4624
2.90	0.5626	0.4101	5.45	0.5269	0.5519	6.95	0.5207	0.4591

include the sound-level reduction obtained due to the distance of the source. For instance, if we measure (at 100 cycles) a sound level of 100 db 4 ft from the source, the level at 400 ft will be 60 db, due to the spreading of the sound-waves in all directions. If we interpose an 18-ft high wall at 100 ft from the source, a further sound-level reduction of 13 db will result according to the above calculations, so that the level measured at 400 ft from the source, with the wall interposed, will be approximately 47 db.

In conclusion, the writer would like to say that the "theory" outlined above has been well corroborated by such tests as he has made on walls and fences, as shown in Fig. 2.

APPENDIX

In the optic case, as well as in the acoustic one, there exist a number of intensity maxima and minima above the point A (see lower part of Fig. 1). These have not been considered in the calculations.

Figure 4 shows, for quick computation, the sound-level reduction as a function of v, the variable used to obtain the Fresnel Integrals. It is seen that for $v = 0$ the sound-level reduction is 6 db. This means that at the point A (lower part of Fig. 1) the intensity is 6 db less than it would be if the wall were not there.

Analysis of Background Process Screens

By ARMIN J. HILL

Development of improved translucent screens for process projection has resulted from improved manufacturing techniques which have been accompanied by a systematic study of the characteristics of these screens and improved instrumentation for measuring and controlling these characteristics. This paper discusses the "semi-diffuse" transmission of light by translucent screens, using an empirical approach which has been found very useful in the analysis of these screens and which can readily be adapted to reflective screens as well. Applications of this method to the analysis of screen characteristics are considered and a way of rating screen performance against the optimum which might be expected for a given type of screen is indicated.

For many years now the use of translucent screens on which motion or still pictures are projected to form a background for live action has been an important method of composing background and foreground subject matter.[1–3] Screen fabricators have become highly skilled in the manufacture of excellent large seamless screens which are free of streaks, localized patterns or other defects, and which effectively redirect the light from the projector to the camera without excessive "hot-spot."

Originally, these screens were developed on the basis of trial and error, with past experience serving as the only guide in the formulation of a new screen. This procedure was acceptable for black-and-white photography because the projectors then available could usually fill the largest screens with sufficient illumination to give satisfactory results. The advent of color required higher light intensities on the sets, and this reduced the size of screen which could be used to give a good background picture. A further increase in set lighting levels to give the improved quality required for large-screen projection further reduced usable size of background screens, until it began to appear that the background projection process would be limited to very small "fill-in" types of shots.

As early as 1948, the Motion Picture Research Council realized that an important contribution could be made to this type of process photography by increasing the effectiveness of these screens. Such an increase could best be made on the basis of a systematic analysis of screen characteristics as related to the conditions under which these screens would be used in the studios. Attention was not confined to translucent screens, but included all types of projection screens, and as this work has progressed, several reports treating both theory and application have been issued.[4–7]

Successful applications of these results have already been made in the development of a highly effective drive-in theater screen,[8] in the formulation of proposed standards for indoor theater screens,[9] and in the improvement of manufacturing techniques which have led to the development of much more effective translucent screens.[10]

This paper is intended primarily to present terminology and mathematical formulations which have been found useful in recent phases of this screen-analysis project. Those characteristics which have been found to be useful in the evaluation of screen effectiveness will be discussed, and ways in which they have been used to guide programs of screen improvement will be indicated. Results of actual screen tests will, however, be used only incidentally, as this paper is intended to discuss methods rather than

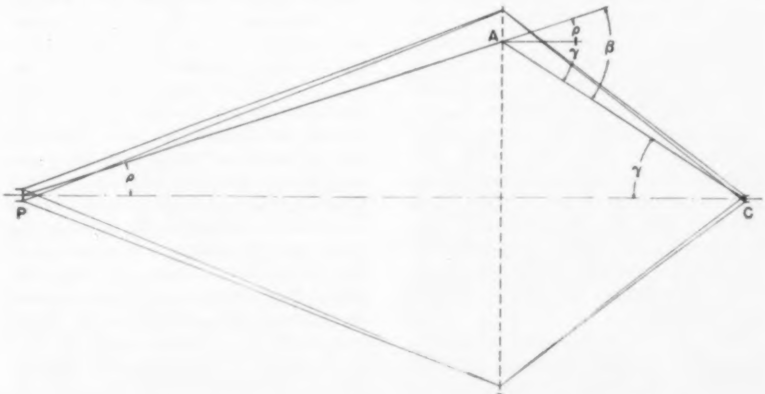

Fig. 1. Usual arrangement of projector, screen and camera for background process projection.

Presented on October 8, 1956, at the Society's Convention at Los Angeles by Armin J. Hill, Motion Picture Research Council, Inc., 6660 Santa Monica Blvd., Hollywood 38.
(This paper was received on May 14, 1957.)

test results. Likewise, but little mention will be made of the measuring instruments and techniques which have been used because a later report is planned to cover these topics.

An empirical rather than a theoretical treatment is used for the reason that calculations based upon the more fundamental theories of radiation transfer and light scattering in translucent media are too complex to be of practical application in the problems treated here. On the other hand, an empirical extension of Lambert's law[6] has been found to work very well, to give simple, workable equations and, with suitable modifications, to fit almost any practical screen characteristic as closely as may be desired.

Background Projection

Most background projection is from the rear, through a translucent screen arranged as shown in Fig. 1, with the projector, P, and the camera, C, roughly along a line perpendicular to the screen, S. Light from the projector forms an image on the screen and the camera photographs this image by means of light which is redirected to it by the screen. For example, that area of the image near point A in Fig. 1 will be photographed by the camera only if a portion of the light which leaves the projector in the direction PA is redirected by the screen in the direction AC. The angle through which this useful portion of the incident beam is deviated will be termed the *bend angle*, β. It will be noticed that it is equal to the sum of the *projection angle*, ρ, and the *camera* (*or viewing*) *angle*, γ.

A practical screen usually redirects but a small portion of the incident light toward the camera. Nevertheless, only the light so redirected is useful in making the composite photograph. Therefore the ability of a screen to so redirect the incident light that it will enter the camera lens can be termed its *effectiveness*. If this ability could be increased so that a major portion of the light from the projector would be properly redirected, a lamp emitting but a very few lumens could replace the powerful projection equipment presently required. To accomplish this would, however, require a very large-diameter field lens or its optical equivalent near the image plane. The diameter of this lens would have to exceed the diagonal of the largest picture which would be photographed and, furthermore, the quality would have to be such that the lens would not appreciably deteriorate the quality of the projected image.

Even if such a lens could be made physically, it is obvious that it could be used only with the projector and camera in definitely fixed positions relative to it. Such a restriction on camera motion could not be tolerated in practice.

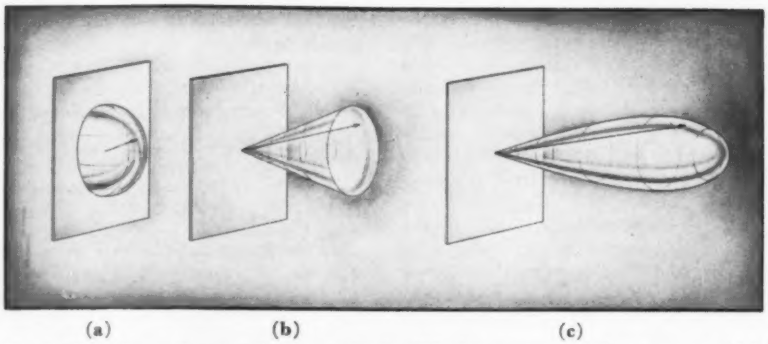

Fig. 2. Diffusion patterns: (a) for a perfectly diffusing screen; (b) for a screen which radiates within a limited angle; (c) for a typical directional-type diffusing screen.

The other extreme would be to use a screen which diffused the light perfectly so that any spot of the screen would appear equally bright from any direction in front of it. The camera could then have unrestricted freedom of motion or positioning. Unfortunately, such a screen redirects such a small portion of the incident light in any one direction that only in very small sizes could it be illuminated sufficiently to give an adequate exposure with light levels now in use.

A practical translucent screen must, therefore, be a compromise between these two extremes. Some degree of camera motion should be permissible, and the greater this freedom, the more usable is the process in a variety of situations. On the other hand, it is generally found that the greater the degree of camera motion permitted, the smaller is the proportion of incident light which can be properly redirected — in other words, the smaller the screen that can be used with a given lumen output of the process projector.

A more effective compromise than is now obtained could be realized were it not for practical difficulties in screen fabrication. For example, an obvious way to confine most of the redirected light in the area in which the camera may be located (the *camera area*) is to use a Fresnel type of field lens immediately on the projector side of the image plane, with a thin diffusing surface in the image plane. So far, no practical methods have been found for fabricating a high-quality lens of this type in the sizes required, and experiments with small ones have shown that they are subject to distracting moire and diffraction patterns which can be removed only by adding so much diffusion that the effectiveness of the lenticulation is lost. Similar difficulties have been encountered in other attempts to use lenticulation on translucent screens, although some types of lenticulation have been used successfully in reflecting screens.

The Viewing or Fall-Off Pattern

If a translucent screen is illuminated by a projector in which no film is running, all parts of it will not appear uniformly bright, even when the incident illumination is uniform over the screen surface. Instead, those areas near the line between the observer and the projector will, in general, appear relatively bright (an effect referred to as "hot-spot") whereas the edges and corners will be noticeably darker. This *viewing* or *fall-off* pattern will generally change with a change in the position of either the observer or the projector relative to the screen. It is therefore a characteristic of the particular projector-screen-observer (or camera) system, rather than of the screen itself. Nevertheless, **this pattern determines whether or not the picture presented to the camera by the screen is illuminated satisfactorily.** In evaluating a given screen, we are therefore particularly interested in the manner in which the various screen characteristics affect the viewing pattern which will be given by that screen under various projector-screen-camera arrangements.

If the screen were a perfect diffuser and could be assumed to transmit all the incident light without loss, the brightness (luminance) of any element as seen from the camera side would depend only upon the intensity of the incident light. The viewing pattern would then be directly related to the variation in incident illumination, i.e. to the *illumination pattern*, from the projector. Actually there will, of course, be transmission losses so that the light radiated by a given screen element will be somewhat less than the light incident on that element. The ratio of the radiated to the incident luminous flux can be termed the *transmissivity* of the screen element. The viewing pattern of a perfectly diffusing screen will therefore depend only upon the illumination pattern of the projector and the transmissivity characteristics of the screen.

The Diffusion Pattern

Most screens are not perfect diffusers. In other words, they do not radiate the luminous flux which passes through them (or is reflected by them) so that any given

Table I. Error Introduced by Substituting Bend Angles in Actual Diffusion Pattern for Viewing Angles in "Normal" Pattern Obtained With Same Intensity of Illumination and Disregarding Dissymmetry Resulting From Non-Normal Incidence of Illumination.

Bend angle	Screen A	Screen B
0°	3.4%	4.0%
5	1.0	1.0
10	3.4	1.6
15	3.4	2.4
20	3.2	2.6
25	1.9	2.0
30	1.4	1.5

spot will appear equally bright as viewed from any direction. To display this characteristic we can let the brightness (or luminance) of a given screen element, as seen (or measured) from a given direction under a specified condition of illumination, be represented by a vector pointing in the direction from which the observation or measurement is made and having a magnitude representing the value of the luminance. All such vectors emanating from a given point of the screen surface will fill a solid which is bounded at its base by the screen surface and at all other points by the end points of the vectors. Such a solid can be termed the *diffusion pattern* for the screen at the point under consideration and for the specified conditions of illumination.

A perfectly diffusing screen, for example, will have all vectors equal in magnitude so that they fill a hemisphere as shown in Fig. 2(a). If, in some manner, such as by the use of properly shaped lenticulations, all of the light can be directed into a cone, with all vectors within the cone having equal magnitudes, the luminance pattern will appear as in Fig. 2(b). A much more common pattern, particularly for translucent screens, is one which is lobe-shaped, having one direction in which the luminance is a maximum, as illustrated in Fig. 2(c). A screen which has this kind of diffusion pattern is said to be *directional*, as contrasted with the nondirectional types having patterns similar to Fig. 2(a), or those which are nondirectional within certain limiting viewing angles as illustrated by the pattern of Fig. 2(b).

With illumination normal (perpendicular) to the screen, each of the patterns shown in Fig. 2 will have axial symmetry about the extension of the line representing the incident beam. Some patterns will have two planes of symmetry giving different axial sections in these two planes. If these sections or *profiles*, are of the same general shape, i.e. "lobe-shaped," or "fan-shaped," for example, the pattern can be termed *bisymmetrical*. If they combine two different types, as for example, a "fan" type with a "lobe" type, the pattern can be referred to as a *combination pattern*.

All patterns, except the "perfect" or "Lambert" diffusion pattern of Fig. 2(a), will lose some symmetry when the incident illumination is not normal to the screen. Generally also, the maximum vector of the lobe-type patterns will not remain exactly along the direction of the incident beam. Fortunately this change in shape and direction is not serious for angles of incidence used in background process projection as these will practically never exceed 10°. Therefore, by using the bend angle of the actual projector-screen-camera arrangement as the viewing angle for the pattern obtained with normal illumination, and disregarding the slight dissymmetry introduced by the projection angle, we can use this "normal" diffusion pattern for predicting screen appearance without appreciable error.

To indicate the magnitude of the errors introduced in making this substitution of the "normal" pattern for the actual one, Table I gives them for a projection angle of 10° and for two different screen samples having quite different diffusion characteristics. The 0° values represent the percentage difference in the magnitude of the maximum luminance vectors for the screen under normal illumination and under illumination of the same intensity at the 10° projection angle. The other values represent percentage errors when luminance for the specified bend angle is obtained from the "normal" pattern at an equivalent viewing angle. Since instrumental and random errors in screen luminance measurements are usually of the order of 10%, it can be seen that these errors can safely be neglected, and they are larger than will ordinarily be encountered in this type of analysis.

The "Hot-Spot" and Its Control

We are now in position to give further consideration to the relationship between the diffusion pattern and the viewing pattern for a typical directional screen. Figure 3 is a sketch of a plan view showing diffusion patterns for each of three points, one directly along the line joining projector and camera, and one on each side of this line. The axes of the side patterns will (for small projection angles) fall practically along the lines of the incident rays and, as has just been shown, the patterns can be considered as being symmetrical about these axes.

An observer in the position shown in the figure will see the center area as having a brightness proportional to the length of the maximum vector of the pattern, whereas the side points will appear considerably less bright as shown by the short vectors pointing toward the observer's position. This means that the observer will see a "hot-spot" near the center of the screen. Furthermore, the

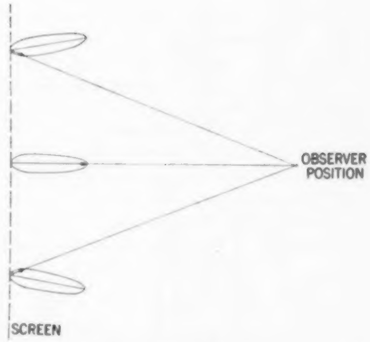

Fig. 3. Relation of diffusion pattern to hot-spot effect.

seriousness of this effect, as measured by the relative lengths of the observed vectors, is far more dependent upon the shape of the diffusion pattern than it is upon the variation of illumination from the projector.

Actually, Fig. 3 shows quite well most of the factors which affect the hot-spot. If the observer moves away from the screen, the effect will obviously be less serious as the lengths of the side vectors increase relative to the central maximum. Moving toward the screen will make the effect worse. When the observer moves parallel to the screen, it can easily be seen that the center of the hot-spot will move with him, keeping its position along the line between him and the projector.

Control of the hot-spot can be effected in three ways: (1) through control of the position of the observer (or camera) and projector relative to the screen, i.e. through the control of the maximum bend angles in the field of view of the observer (or camera), since the length of the maximum vector will not change appreciably, and the lengths of the side vectors will be directly related to these maximum or *limiting* bend angles; (2) through control of the shape of the diffusion pattern of the screen; and (3) through control of the illumination pattern from the projector.

For a fixed combination of projector and camera lenses, the simplest although actually the least effective control is obtained by reducing the intensity at the center of the projected beam through use of some form of "hot-spot eliminator." This is usually an opaque disk which is inserted in the light path at or near the projector to cast a diffuse central shadow over the hot-spot area. Successful use of such a device requires skillful manipulation, particularly when the camera is to move during the photography of a scene. Furthermore, the amount of control obtainable with this device is definitely limited to a reduction of the intensity in the center of the hot-spot to about one-half its uncontrolled value.

Experience has shown that with a

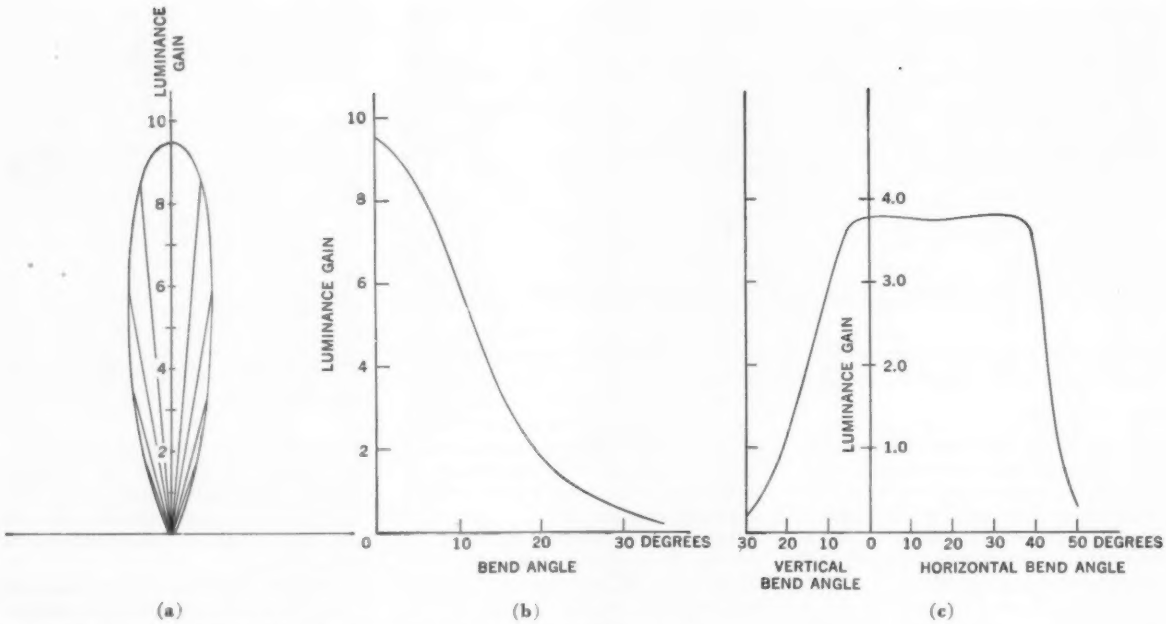

Fig. 4. Gain profiles: (a) polar form; (b) rectangular form; (c) combination pattern.

4:3 aspect ratio, the center of the hot-spot (controlled) can be about twice as bright as the edge of the screen. In other words the *luminance ratio* of the viewing pattern can be as high as 2 and still give acceptable results. With wider aspect ratios (2:1 or greater) this can be increased — in some cases as high as 3, acceptably — depending somewhat upon the subject matter of the projected picture. Thus, with the possibility of using hot-spot control in the projected beam of as much as 2 to 1, the original viewing pattern could have a luminance ratio as high as 4 for standard aspect ratios or 6 for wide-screen pictures, without giving serious difficulty.

Bend Angles

In practice, the central areas of the picture will be controlled to match the luminance at the picture edges or corners. In most composition the level at the edges of the picture will be the more important, and it is therefore desirable to have these as bright as possible. In fact, the luminance at these points will be the critical value in determining the acceptability of the overall process. This luminance in turn will depend principally upon the diffusion pattern of the screen at these critical points as related to the corresponding bend angles. These *limiting bend angles* are in turn determined solely by the sizes of the film-gate apertures and the focal lengths of the lenses used in the projector and camera, and are independent of screen picture size or any of the other screen characteristics. They are tabulated in Table II for a few typical combinations, using standard full-frame (0.980 in. × 0.715 in.) apertures in both camera and projector. (It is assumed that the camera film-gate aperture exactly matches the projected picture and that camera and projector are along a line perpendicular to the screen through the center of the picture.)

Table II. Limiting Bend Angle in Degrees (to side of picture).

Camera lens	Projection-lens focal lengths 5 in.	6 in.	7 in.	8 in.	9 in.
30mm	28.1	27.2	26.5	26.0	25.6
50mm	19.6	18.7	18.0	17.5	17.1
75mm	15.0	14.1	13.4	12.9	12.5
100mm	12.7	11.8	11.1	10.6	10.2

Table II shows that under conditions encountered in usual process projection practice a much greater reduction can be effected in the limiting bend angles by increasing the focal length of the camera lens than by using a projection lens of greater focal length. Experience has shown that use of limiting bend angles in excess of about 17° lowers overall effectiveness appreciably. This indicates that the use of a 75mm camera lens is much to be preferred over the shorter focal lengths, and 50mm lenses should be used sparingly.

Screen Characteristics

Actually the diffusion pattern as we have defined it, depends not only upon the screen, but upon the incident illumination also. We have shown that we can safely, within projection angles of 10°, neglect the effect of the projection angle by considering the illumination as being normal to the screen and substituting bend angles for viewing angles. To eliminate the effect of variation in the incident illumination, therefore, we need only to obtain the diffusion pattern **under conditions of normal illumination of unit intensity.**

A perfectly transmitting, perfectly diffusing screen, under such illumination, will have a luminance of unity in any direction. The luminance of any other screen under these conditions can properly be referred to, therefore, as *luminance gain*, or simply as *gain*.* All of the gain vectors emanating from a given point of the screen will form a solid which can be termed the *gain pattern* for that point, and these patterns can be classified as to symmetry in a manner similar to that used for the diffusion patterns. It will be noticed that these patterns now are truly characteristic of the screen itself and are independent of the method of illuminating or observing it.

Luminance gain, as we have defined the term, includes the effects of transmission or other losses in the screen as well as the "power" of the screen to diffuse the light into a suitable diffusion pattern. Often we are concerned only with this latter property, especially when comparing screens of comparable transmission. At the risk of offending those who would reserve the term for energy relationships only, we would therefore

* The CIE terms this *luminance factor*. "Gain" is here used in the same sense as that which for some time has been accepted terminology in reference to electronic amplifiers. Since it may be less than 1.0, it should never be expressed as a percentage. For example, the expression "85% gain" may be confusing, whereas "a gain of 0.85" should not be so. This expression as defined here has already found some acceptance in the literature.[11]

like to define the *luminance power** of a given point on a screen as the luminance (in a specified direction) when radiation of luminous flux in the immediate vicinity of that point is at the rate of one unit per unit of area. For a perfectly transmitting screen, the *power* and the *gain* would be the same. In other cases the ratio of gain to power is the *transmissivity* of the screen at the point under consideration. Since transmissivity may not be independent of direction, it is best defined as the ratio of gain to power in a given direction.

As with the diffusion and gain patterns, it is possible to construct a *luminance power pattern* of the power vectors emanating from a given screen point. Generally, this will have a shape similar to that of the gain pattern.

The Gain Profile and Its Applications

A section through the gain pattern which includes its axis can be termed a *gain profile*. For a typical lobe pattern it will appear as in Fig. 4(a). A more convenient representation is given by plotting it in rectangular coordinates as shown in Fig. 4(b). When the pattern is symmetrical, only one-half need be shown, allowing a full representation of a bisymmetrical or combination profile on one set of coordinate axes as indicated in Fig. 4(c).

When projection angles are small, we can use the gain profile directly to compare the effectiveness of one screen with another for a given projector-screen-camera arrangement. The bend angle at any given point on the screen will be equivalent under these conditions to the viewing angle on the profile, and since we are interested primarily in the conditions near the edges of the projected picture, we can use the limiting bend angles as determined from the projector and camera apertures and lenses. In fact, the luminance gain at the limiting bend angle for a given projector-screen-camera arrangement can be termed the *effectivity* of the screen for this arrangement, since it gives a measure of the effectiveness of the screen as previously defined.

The gain profile can be measured either on a small screen sample or on a full-sized screen simply by illuminating the screen normally at an intensity of 1 ft-c, then reading the luminance in foot-lamberts at various viewing angles. If illumination intensity is not unity, then luminance divided by illumination will give the gain when the former is in foot-lamberts and the latter in foot-candles.

The ratio of center or maximum gain to that at the limiting bend angle will give a measure of the seriousness of the hot-spot. If this ratio is greater than 2 for a picture which is square or which has an aspect ratio of the order of 4:3, or if it exceeds 3 for a wider aspect ratio (of the order of 2:1), some form of hot-spot control will be required in the projector. If the ratios are more than double these values, it is unlikely that any such control will successfully correct the situation. It then becomes necessary either to move the camera or projector farther from the screen by using lenses of longer focal length, or to substitute a screen having a smaller difference in gain between the maximum value and that at the limiting bend angle.

From this discussion it can be seen that with a knowledge of (1) the illumination pattern of the projector, (2) the limiting bend angles given by the projection and camera lenses and apertures, and (3) the gain profile of the screen or other characteristics from which this profile can be obtained, a complete and closely accurate prediction can be made of the viewing pattern and of other factors which affect the successful use of the screen for background process projection.

Theoretical Characteristic Curves

Often complete data are not available to give a satisfactory gain profile. Circumstances may have permitted only a limited number of readings, or perhaps all that is available is a design specification giving desired performance at a few given points. In such cases it is well to be able to complete the profile by using a suitable theoretical curve which matches at the specified points and approximates the probable actual profile as closely as possible.

Again, in many problems it is necessary to relate screen luminance to the incident illumination. In order to do so it is necessary to determine the total radiated luminous flux by integrating expressions involving the magnitudes of the gain — $G(\Theta)$ — or luminance — $B(\Theta)$ — vectors (where Θ is the viewing angle or equivalent bend angle). For symmetrical patterns, such an expression will be of the form:

$$2\pi\int_0^{\pi/2} B(\Theta) \sin \Theta \cos \Theta d\Theta \qquad (1)$$

If actual profiles are available this integration can be carried out numerically. Otherwise it is well to have a functional relationship between the vector magnitude and related angle in a form which will make the integration as simple as possible.

At present we shall confine our consideration to those screens having symmetrical lobe-type patterns. For these, the first-order approximation[6] mentioned previously is very well suited. In this, the assumption is made that the luminous intensity, $I(\Theta)$, of the radiated flux is proportional, not to the cosine of Θ as in Lambert's law, but to some power of this cosine as may be determined from the form of the diffusion pattern. With radiation in accordance with Lambert's law (using the subscript 0 to represent values at zero angle) we have:

$$I(\Theta) = I_0 \cos \Theta \text{ and } B(\Theta) = B_0 \qquad (2)$$

whereas with the cosine-power law we have:

$$I(\Theta) = I_0 \cos^s \Theta \text{ and } B(\Theta) = B_0 \cos^{s-1}\Theta \qquad (3)$$

Upon integrating (1)*, we find that with a perfectly transmitting, perfectly diffusing screen, the uniform luminance B is given by the expression:

$$\pi B = \text{incident luminous flux per unit area} \qquad (4)$$

Now, by definition, an incident luminous flux of 1 ft-c on such a screen will produce a luminance of 1 ft-L. In other words, when these units are used the π-factor in (4) drops out. In all similar expressions in this paper, the use of these units will be assumed, and therefore the π-factor will not appear.

With the cosine-power law, assuming a nondirectional transmissivity, T, integration of an expression similar to (1) using $G(\Theta)$ instead of $B(\Theta)$ gives:

$$T = \frac{2}{s+1} G_0 \text{ or conversely } G_0 = \frac{s+1}{2} T \qquad (5)$$

where G_0 is the maximum gain, and where for any angle Θ,

$$G(\Theta) = G_0 \cos^{s-1}\Theta \qquad (6)$$

We see at once that the luminance power $P(\Theta)$ can be obtained from similar relations:

$$P_0 = \frac{s+1}{2} \text{ and } P(\Theta) = P_0 \cos^{s-1}\Theta \qquad (7)$$

If, now, we wish to determine the gain at the limiting bend angle, β_L, or in other words, the *effectivity* of the screen (representing this by the symbol M), we have:

$$M = G_0 \cos^{s-1}\beta_L = \frac{s+1}{2} T \cos^{s-1}\beta_L \qquad (8)$$

Let us now define the *efficiency* of a screen (or more properly of a screen element) as its ability to redirect the incident light into the camera area. Let this area be defined by a cone with its vertex at the screen element which

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* Power is used here in the same sense as in "magnifying power," "resolving power," etc., i.e. "the ability to act; the faculty of doing or performing something" (see Webster's *New International Dictionary*). It refers here to the ability of the screen to produce a satisfactory luminance pattern.

(*Editorial Note:* Some reservation has been expressed in the Board of Editors regarding this use of the term "power," particularly together with the word "luminance." The Author, after careful thought, has preferred to retain the term.)

* This integration is shown in most elementary texts on photometry. See, for example, Francis Weston Sears, *Principles of Physics*, Vol. III, Optics, 3d ed., Addison-Wesley Publishing Co., Cambridge, Mass., 1948, pp. 339–341.

includes all required positions of the camera lens. If this cone is circular, having a half-angle β_C, the efficiency, $\mathcal{E}$, will then be given by:

$$\mathcal{E} = 2G_0\int_0^{\pi/2} \cos^s \Theta \sin \Theta d\Theta = \frac{2}{s+1} G_0(1 - \cos^{s+1}\beta_C) \quad (9)$$

or

$$\mathcal{E} = T(1 - \cos^{s+1}\beta_C) \quad (10)$$

Occasionally, problems arise in which exposures obtained by rephotographing illuminated translucent or reflective screens must be predicted. As shown in any elementary text on photometry,[12] the exposure X, obtained from a perfectly diffusing, uniformly illuminated screen of luminance B, when an angle α is subtended by the radius of the exit pupil of the camera lens at the film plane in the camera, is given by:

$$X = B \sin^2\alpha \quad (11)$$

If the screen is not a perfect diffuser, but has a pattern which can be approximated by the cosine-power law, this equation takes the form:

$$X = B_0 \frac{2}{s+1} \frac{1 - \cos^{s+1}u}{\sin^2 u} \sin^2 \alpha \quad (12)$$

where u is the angle subtended by the radius of the entrance pupil of the camera lens at a point on the screen, and X is the exposure for a point on the optic axis when the maximum vector B_0 is directed along this axis. Generally in practice, the angle u will be very small, in which case the fraction $(1 - \cos^{s+1}u)/\sin^2 u$ approaches $(s + 1)/2$ reducing equation (12) to:

$$X = B_0 \sin \alpha \quad (13)$$

Under these conditions the object and image points need not be on the axis for (13) to hold to a close approximation provided that, instead of B_0, the value of the luminance $B(\beta)$ in the direction of the center of the entrance pupil of the camera lens is used.

How Good Is the Cosine-Power Approximation?

We have illustrated that important information related to screen performance can be predicted by using the cosine-power approximation of the gain profile, knowing only the power factor s and the transmissivity of the screen, with information on incident illumination values when needed. The question naturally arises: how good is the cosine-power approximation? Can it be used safely in predicting screen operation when the value of s is determined from one set of readings only, or should an average value of s obtained from several readings be used? If the approximation is not good enough, can it be modified suitably without losing its valuable properties?

Schwesinger[13] has suggested another approximation which, while it does approximate the shape of a typical lobe-type profile, does not lend itself to integration as readily as does the cosine-power form. Figure 5 illustrates these two approximations as applied to two actual profiles, one having a relatively high maximum gain, the other a relatively low gain. Each approximation is fitted to match the actual profile at 0° and at 10°. It is seen that the cosine-power curve fits the high-gain profile somewhat better than Schwesinger's approximation, whereas the latter fits the low-gain profile somewhat better. Generally, the cosine-power curve drops off too sharply at large angles, thereby neglecting effects of wide-angle diffusion. These can be quite important because, though the values are small, the angles radiated into are large. On the other hand, Schwesinger's curve overemphasizes these wide-angle values, with results which may be even more serious.

In either case, if the curves are to be fitted more exactly, additional parameters are needed. An obvious modification of the cosine-power law can be made by considering s to be a function of Θ. A comparatively simple relationship which introduces one additional parameter, K, is given by:

$$s(\Theta) = s_0 \exp K \cos \Theta \quad (14)$$

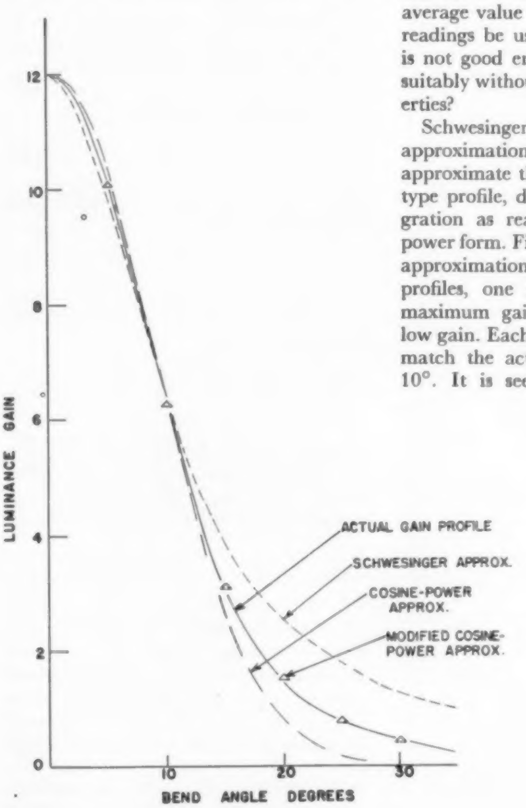
where s_0 is the value of s at $\Theta = 0$. This has been found to fit actual profiles very well, but not as closely as a three-parameter expression:

$$s(\Theta) = s_0 \exp -k(s_0 - 1)\Theta^m \quad (15)$$

The closeness of this fit is shown by the small triangles in Fig. 5. The resulting curve must be integrated numerically, but experience with it shows that it works very well where initial data are incomplete and where the wide-angle diffusion must be given more exact consideration than it receives with the simple cosine-power form. Furthermore, it has been found that the parameters K, or k and m, serve very well as figures of merit in specifying suitable screen characteristics, as will be evident in the following discussion.

The Ideal Screen

For the present, confining our attention to lobe-type screens, and assuming that their profiles can be suitably approximated by one of the above-mentioned modifications of the cosine-power law, we would like to find the values of



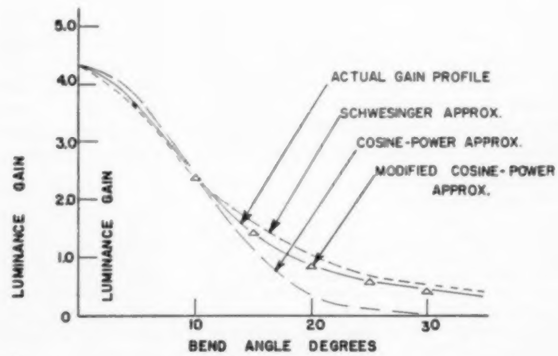


Fig. 5. Theoretical fitting of actual gain profiles: (a) typical high-gain profile; (b) typical low-gain profile.

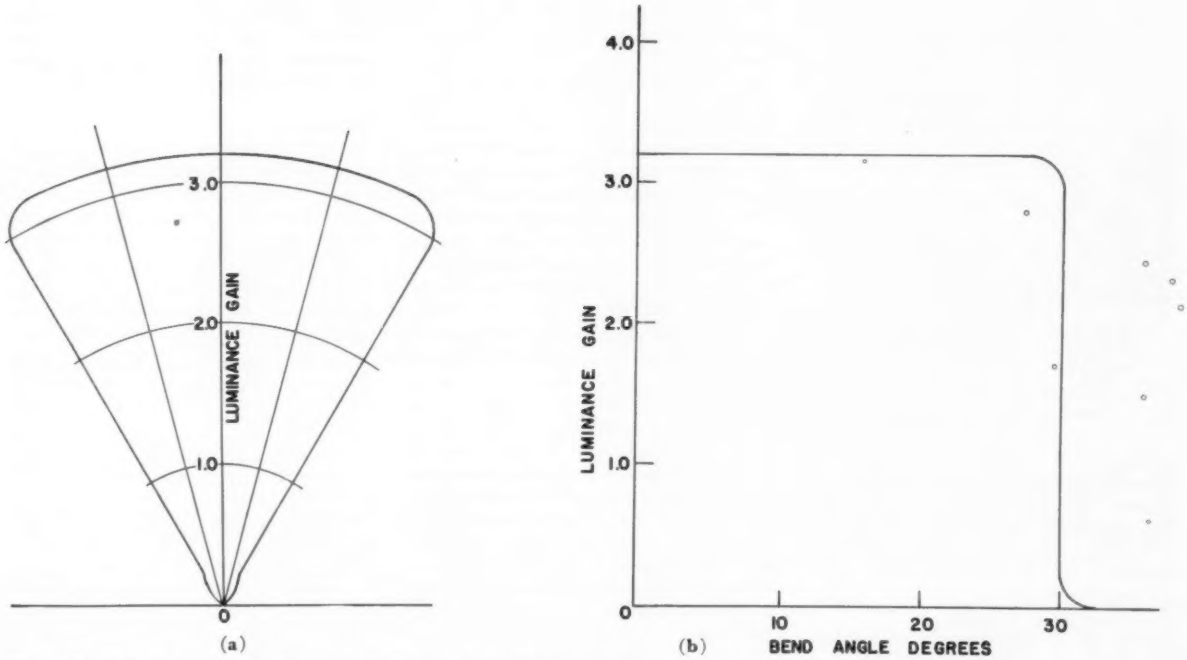


Fig. 6. Ideal "fan-shaped" profile: (a) polar form; (b) rectangular form.

the parameters which would give maximum effectiveness at some specified limiting bend angle. If such maximizing values can be found, then certainly they will indicate the ideal screen of this general type against which actual screens can be compared in order to find the best way to make improvements.

What we wish is that the value of $G(\beta) = G_0 \cos^{s(\beta)-1} \beta$ be a maximum for a given bend angle, β, under the condition that the integral $\int_0^{\pi/2} G(\Theta) \cos^{s(\Theta)}\Theta \sin \Theta d\Theta$ remain constant. In general, it appears that no single form of the function $s(\Theta)$ will invariably give the maximum value of $G(\beta)$ for all values of β within the interval from 0° to 90°. However, for values which do not exceed about 40°, it can be shown that for functional forms of the type given in (14) or (15) such a maximum will be obtained when the parameter K (or k as the case may be) is zero — in other words, when s is a constant, independent of Θ.

In short, in the interval range of interest in all work with process screens, the most effective type of screen having a general lobe-shaped pattern is one which follows the cosine-power law with the power factor constant. From this it follows that the smaller the values of the parameter K or k (and likewise the parameter m, for it is related to the seriousness of wide-angle diffusion), the more effective will be the screen. This situation has been found to hold true in practical tests on widely varying screen types.

Now assume that a suitable screen could be fabricated having a "fan"-shaped profile or cone-shaped pattern as illustrated in Fig. 2(b). The gain profile would then appear as in Fig. 6, with the "cutoff" angle determined by the desirable half-angle of the cone subtending the useful camera area, β_C. The gain and power of such a screen would be given by:

$$G = T \csc^2 \beta_C \quad (16)$$

$$P = \csc^2 \beta_C \quad (17)$$

The effectivity would be the same as the gain, and the efficiency would equal the transmissivity. There would be no difficulty with hot-spotting as long as all angles were kept less than β_C, and the camera could move within the limits set by this angle without difficulty.

Certainly such a screen could be termed "ideal" in every sense of the word for it would give the maximum ratio of luminance to incident illumination for any specified degree of camera movement. Unfortunately, to date, no practical suggestions have been made as to how such a screen could be fabricated with reasonable facility in sizes which would be practical for background process projection.

Maximum Effectiveness for Translucent Screens

To find the cosine-power curve which will give maximum gain at a specified limiting bend angle, β, we differentiate the gain with respect to s, holding Θ constant at β, and set the result equal to zero:

$$dG(\beta)/ds = \frac{\delta G_0}{\delta s} \cos^{s-1}\beta + G_0 \cos^{s-1}\beta \log \cos \beta = 0 \quad (18)$$

Now from (5) we have $G_0 = T(s + 1)/2$, so that assuming T to be independent of s, we have $\delta G_0/\delta s = T/2$ and substituting in equation (18) we find that:

$$s = -\frac{1}{\log \cos \beta} - 1 \quad (19)$$

giving us the value of s for the cosine-power gain curve which has the greatest gain at the bend angle β. The maximum gain — or maximum effectivity — at the given bend angle is therefore:

$$G_m = T \frac{s+1}{2} \cos^{s-1}\beta \quad (20)$$

where s is given by (19). If T is not independent of s, then the functional dependence must be ascertained from screen tests, changing the form of (19) to:

$$s = -\frac{1}{\delta T/T\delta s + \log \cos \beta} - 1 \quad (21)$$

thus modifying the value of G_m slightly.

If we now assume no transmission losses, i.e. that $T = 1$, we obtain the maximum luminance power for this general type of screen for each given bend angle. These can be plotted as shown in Fig. 7. This curve is an "envelope" of the luminance-power curves. In other words, each point on it represents a different power profile which will be tangent to the plotted curve at that point. From it, we can obtain the maximum effectiveness which can be expected from an idealized perfectly transmitting screen having a lobe-type distribution pattern.

This curve, therefore, represents the maximum values which can be obtained with this type of screen, and therefore serves as a guide in the improvement

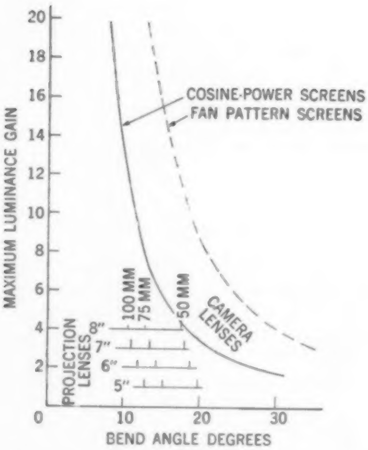


Fig. 7. Envelopes of idealized gain curves for perfectly transmitting screens showing maximum gain which can be attained for each type as a function of bend angle.

which can be expected. For example, a few years ago the best screens available had gains of less than 1.5 at a bend angle of 17.5°. We find from Fig. 7 that the gain at this angle might be as high as 4.13, or assuming a reasonable value of T as 85%, this value would be 3.51. Recent screens have shown gains at this same angle of about 3.50, indicating that they are now about as good as they can ever be expected to be.

What improvement can be expected by going to lenticulated types? Figure 7 also shows the maximum gains which can be anticipated for "ideal" screens of the type shown in Fig. 6. Again looking at a bend angle of 17.5° (which now becomes the "camera area angle"), we see that these screens might have gains as high as 11.06, indicating a possible improvement over lobe-type screens of about 2.5 times. This would increase possible screen dimensions by about 60%. Whether or not such an improvement is economically worthwhile will depend upon the probable cost of such screens if and when practical methods of fabrication can be devised.

From this discussion it is apparent that a screen which gives the highest gain for one projector-lens combination will not be the best for any other. For example, if a screen is used most effectively for a picture 14 ft wide when an 8-in. lens is used on the projector and a 100mm lens is used on the camera, the same screen could be used for a picture only 3.0 ft wide with a 5-in. projector lens and a 50mm camera lens. Now, if a screen is substituted which will give the maximum edge-gain for the 5 in.–50mm combination, the same projector would illuminate a picture 8.0 ft wide, but this screen would give a picture only 10.75 ft wide when used with the 8 in.–100mm combination. This clearly indicates the need of careful analysis of all probable screen-operating conditions before specifying screen characteristics.

This analysis of translucent screens in terms of gain at limiting bend angles is therefore seen to provide a convenient and directly applicable method of gauging screen effectiveness under any specified operating conditions. When used with suitable approximations of gain profiles (when actual profiles are not available), it provides a very useful guide for the development of new screens.

References

1. E. J. Wall, "Some patents for trick photography," *Trans. SMPE, XI-30:* 328–333, Aug. 1927.
2. G. G. Popovici, "Background projection for process cinematography," *Jour. SMPE, 24:* 102–109, Feb. 1935.
3. A. Farciot Edouart, "Work of the Process Projection Equipment Committee of the Research Council of the Academy of Motion Picture Arts and Sciences," *Jour. SMPE, 33:* 248–253, Sept. 1939.
4. Progress Report, "Transparency screens and process photography," Motion Picture Research Council Bulletin N-124 (not published), Jan. 1950.
5. Herbert Meyer, "Transparency screens and process photography," Motion Picture Research Council Bulletin No. 144 (not published), June 1950.
6. Armin J. Hill, "A first-order theory of diffuse reflecting and transmitting surfaces," *Jour. SMPTE, 61:* 19–23, July 1953.
7. Progress Report, "All-purpose theater screens," Motion Picture Research Council Information Bulletin No. 7, Aug. 1953.
8. Petro Vlahos, "An improved drive-in screen," Motion Picture Research Council Informational Bulletin No. 13, Oct. 1954.
9. "Screen brightness for 35mm theaters," Proposed Motion Picture Research Council Practice (not yet approved), April 1956.
10. C. R. Daily, "High-efficiency rear-projection screens," *Jour. SMPTE, 65:* 470–477, Sept. 1956.
11. France B. Berger, "Characteristics of motion picture and television screens," *Jour. SMPTE, 55:* 131–146, Aug. 1950.
12. See, for example: George S. Monk, *Light, Principles and Experiments*, McGraw-Hill Book Co., New York, 1937.
13. Gerhard Schwesinger, "Proposal of a performance rating for projection screens," *Jour. SMPTE, 63:* 9–14, July 1954.

New Variable-Color Luminous Studio Wall

By ROLLO GILLESPIE WILLIAMS

Important developments in studio color techniques that are possible through use of a new high-intensity variable-color luminous wall are discussed. This wall can be provided with means for instant control of hue, chroma and brightness and, for areas up to 3000 sq ft, need be only 12 in. deep. A luminous background of this type can immediately produce important color shifts in appearance of foreground objects, enabling color defects to be remedied. Group colors in a foreground arrangement can be harmonized and specific colors emphasized. Dramatic possibilities include mobile color effects, luminous skies, design patterns, scenic effects, silhouettes and color contrasts. Technical information concerning brightness values, color range, current consumption and control methods are also discussed.

Color perception is initiated by physical stimulation of the retina by light, but many physiological and psychological factors also influence the appearance of observed colors. The inherent color of an object has no fixed appearance value, but can vary widely according to the spectral quality of the illuminant, color and brightness values of the environment, state of adaptation of the observer's eye and many other factors. Finally, the mental attitude of the observer may influence color perception. The thresholds between the physical, physiological and psychological values are difficult to define but the influence of these factors on the appearance of both color and form are very marked.

Objective color can be defined by the factors of hue, saturation (chroma) and brightness (value). These values can be stated accurately in a physical sense, but their appearance can be defined only relative to certain specified conditions such as the spectral quality of the illuminant, viewing conditions, data representative of a normal (standard) observer and other factors. For example, even the appearance of spectral hues can be changed by observing them in an environment with certain contrasting hue and brightness values. Saturation and brightness appearances can also be varied in the same manner.

The phenomena of color changes produced by contrast relationships that are viewed simultaneously are known as *simultaneous contrast*. Under suitable conditions this factor of contrast is so influential that white light itself can appear as colored light and the apparent color of the light can be changed to any one of a number of hues. White areas can appear colored, and colored surfaces changed in hue. The phenomenon of simultaneous contrast also concerns achromatic colors (white, gray and black) as seen in Fig. 1.

Another important contrast factor is known as *successive contrast*. This comes into play when the eye looks from one colored object to another of a different color. Immediately following the eye movement there may be a temporary change in the appearance of the second color. Figure 2 gives some examples of contrast relationships.

The utilization of this contrast phenomenon is one of the purposes of the new Century Color Value Wall. The luminous surface of this wall can glow with color of almost any desired hue and can attain a surface brightness as high as 585 ft-L. The appearance of colored objects viewed in front of it can be very much influenced by the background contrast relationships thus provided. Contrast phenomenon applies to color relationships seen on a TV color picture tube as well as elsewhere, and a desired color shift can be given to the perceived color of a foreground object by suitable adjustment of the background color and brightness. Unlike color shifts obtained by use of TV "gain controls," when the whole picture is affected by adjustment of the red, green and blue values, a particular color can be influenced without upsetting the color balance of the picture.

Thus, a red package, with colored letters and designs upon it, can be viewed in front of the Color Value Wall adjusted for hue and brightness, so that the package is seen very definitely to have red of the desired tone without spoiling the appearance of the package lettering and design. Adjustment of "gain controls" to produce the desired red might upset the appearance of the other colors in the design. In the case of a red dress, such adjustments might have a disastrous effect on the complexion of the person wearing it. The Wall could help to determine the red of the dress without spoiling the looks of the wearer.

The Color Value Wall comprises a structure containing lighting equipment and a white translucent screen. The lighting is governed by brightness controls that are located elsewhere. The one-piece special diffusing screen is made of

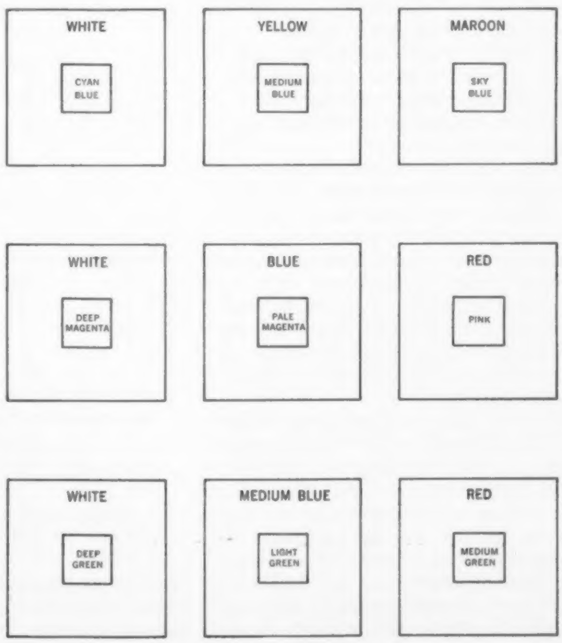


Fig. 1. Illustration of the phenomenon of simultaneous contrast. The three center squares in each row are actually identical, but appear to differ according to the background color.

Presented on April 30, 1957, at the Society's Convention at Washington, D.C., by Rollo Gillespie Williams, Color Lighting Dept., Century Lighting, Inc., 521 W. 43 St., New York 36.
(This paper was received on April 4, 1957.)

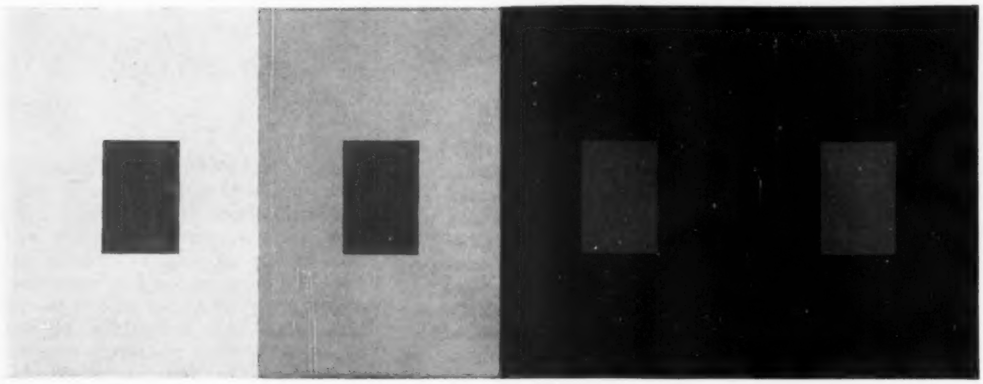


Fig. 2. Examples of black-and-white contrast relationships: the center is exactly the same in each case. (Reproduced, with permission, from the Kodak Data Book, *Color As Seen and Photographed.*)

ethyl cellulose and is stretched into a frame so that it constitutes one side of the "wall." The lighting equipment is immediately behind it and is contained in a depth of structure that can be as little as 12 in. The wall can be self-contained and free-standing, or both screen and lighting equipment can be separately mounted. One recent self-contained, free-standing TV Color Value Wall provided a luminous surface 14 ft wide by 8 ft high. Walls can be constructed with one-piece screens up to 86 ft in width and 46 ft in height or may be as small as 4 ft by 4 ft. They may be either flat or curved.

The lighting equipment comprises a combination of fluorescent and incandescent filament lamps so positioned behind the screen that it becomes luminous with smooth diffused lighting free from brightness spots or shadows. The effect is that of an area of pure luminous color.

Use is made of the fact that fluorescent lamps can be made to emit directly light of certain colors, and for these hues they do not require color filters to absorb part of the spectral output. Thus, a single 40-w fluorescent lamp can provide 1100 lumens of blue light, which is the equivalent, perhaps, of 800 w of incandescent filament lamps fitted with blue color filters. Furthermore, the light output emanates from the surface of a $1\frac{1}{2}$-in. tube 48 in. long and has a relative low surface brightness, which is helpful for diffusion.

However, fluorescent lamps provide poor output at the red end of the spectrum and the mercury lines are always present in light radiated from the lamp discharge. The colors are far from pure and the blue, for example, is relatively desaturated. Figure 3 shows spectral-energy distributions for a number of typical fluorescent lamps.

To overcome these drawbacks, incandescent filament lamps in conjunction with color filters are used to provide saturated *red* light in the Color Value Wall. Fluorescent hot-cathode lamps are employed for *blue* and *green* lighting circuits. Where more saturated colors are required, colored filters are employed with the fluorescent lamps. It has been found desirable to have a fourth circuit of fluorescent gold lamps to provide a *yellow* light. Orange, for example, can then be obtained by blending the red and yellow currents; or amber and lemon, by mixing the green and yellow circuits. A high-intensity yellow is thus available and near-white tints can be produced by blending two or more of the different fluorescent colors because of their relative desaturation.

The difficulties experienced with the fluorescent white light spectral distributions in color TV studio lighting are not encountered in this case, because any blending of incandescent filament and fluorescent light sources takes place to provide a single resultant color mixture and the spectral distributions are not seen separately.

The connected lamp load depends to some extent on the depth of space available for the Wall. The maximum loading can be used for any depth greater than the minimum of 12 in. (front to back), but if smaller loads are required then the depth must be increased. Thus, with a depth of 20 in., the connected load can be reduced to 50% of maximum. The maximum total connected load for the four colors can be approximately 93 w/sq ft of luminous area. The operating load at full brightness would then vary between 15 and 93 w/sq ft with an average working load of approximately 37 w/sq ft.

A translucent area 12 ft 6 in. wide by 8 ft high would thus have a maximum total connected load of 9300 w with operating loads as low as 1500 w and an average working load of 3700 w. Because of these moderate loads there is no problem with heat and the whole Wall remains relatively cool.

The brightness of the luminous area is adjusted by means of dimmer controls. Each fluorescent color circuit is provided with means of brightness control which enable the intensity to be reduced to a low level. Hot-cathode lamps are employed in conjunction with special ballasts and a reactor control circuit. The incandescent filament lamps are controlled by an autotransformer or other convenient type of dimmer.

These brightness controls may be di-

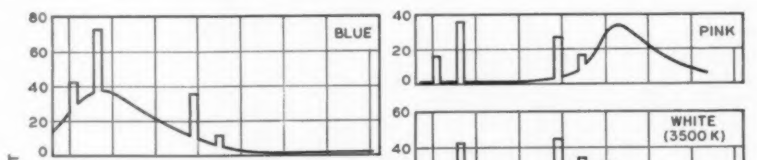


Fig. 3. Spectral-energy distributions for a number of typical fluorescent lamps. (From *IES Lighting Handbook, 2d ed.*, 1952, published by the Illuminating Engineering Society, New York.)

Fig. 4. A color-selective controller, single-preset type. Any selected color can be modified at will, and the dimmers can be individually operated when required.

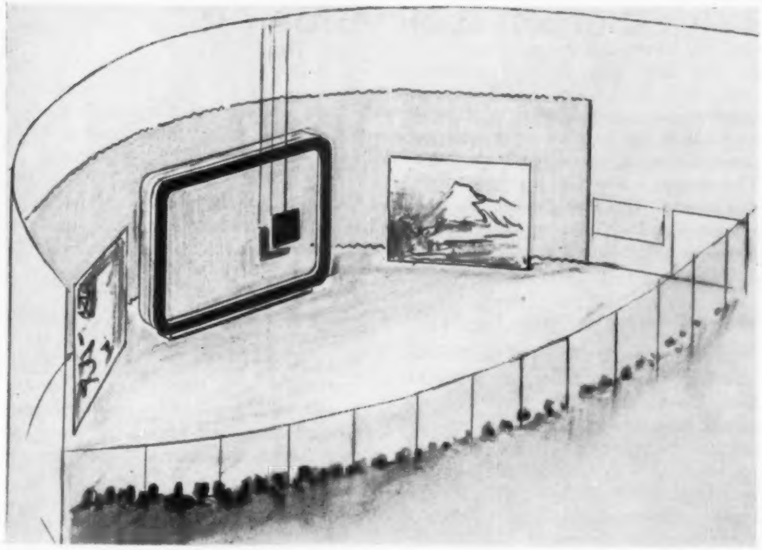


Fig. 5. A free-standing Century Color Value Wall exhibited in the Tokyo 1957 International Trade Fair. (Reproduced by courtesy of Cushing & Nevell, Designers.)

rectly or remotely operated, or may be embodied in a color-selector type of control unit. Figure 4 illustrates one type of color-selective controller. Desired colors can be selected from a dial and produced in the Wall at any required speed. This controller is of a single-preset type. Any selected color can be modified at will and the dimmers can be individually operated whenever required.

The brightness values of the luminous wall vary according to the color and the dimmer settings. Examples of foot-Lambert values for single-color circuits are as follows:

Green	280 ft-L
Yellow	180 ft-L
Blue	100 ft-L
Red	25 ft-L

Further developments are in hand that promise to provide even higher brightness values, especially in the case of the red. The use of color filters with the fluorescent lamps reduces the foot-Lambert values but, of course, provides deeper colors.

The uses for this equipment are manifold. Reference has been made to simultaneous contrast effects, but its usefulness far exceeds the correction of foreground color shifts. Some of its other applications will now be mentioned.

The sense of hue in a color can be sharpened by viewing it against a background of the complementary color. Complementary colors do not suggest any change in each other, but show the colors up in the most positive manner.

Difficulty is often experienced with cyclorama backgrounds flooded with colored light inasmuch as the foreground lighting may spill onto the cyc surface and wash out the required color. This is particularly likely to happen when foreground objects are close to the background and are lighted with spotlights. The Color Value Wall can be constructed to be curved on one plane, and thus can be used either as a flat or curved cyclorama background. When so used, it overcomes the problem of spill-light from foreground lighting, since the illuminated surface is translucent and the spill-light largely passes through it instead of reflecting off the surface. This can mean valuable conservation of space since the foreground objects can be set much closer to the cyclorama than is usually the case.

This equipment is excellent for silhouette effects. Since all its light sources are behind the translucent surface, there is no spill-light from equipment in front of the wall to offset the complete blackness of the silhouette, should the object be near to the background.

Excellent design effects can be obtained by placing simple cutout forms against the rear of the translucent surface of the Color Value Wall and lighting the front of it in a different color. The front lighting will illuminate those parts of the surface area that are cut off from the background lighting by the solid cutout and these areas will be sharply contrasted by the background lighting on the remainder of the screen. The foreground lighting will have little effect on the latter, since most of the light will be transmitted and not reflected off the surface.

Thus, a cardboard shape of a palm tree could be placed against the rear of the translucent surface and the Wall lighted with blue light. By flooding the front of the surface with green light, the appearance of a green palm tree against a blue sky would be created.

The blue sky provided by nature is luminous and it is difficult to simulate this luminous blue by using either a painted blue backcloth or a white opaque surface flooded with blue light. This equipment provides an area of luminous blue with a diffused brightness of 100 ft-L. This is equivalent to 2000 ft-c of incident illumination on a painted blue surface with a reflection factor of 5%, or to white lighting of the same value before being fitted with blue color filters. Furthermore the luminous area of the wall is completely free from any creases, brightness variations or striations of light.

It is possible to circuit the Color Value Wall so that different areas of the translucent surface can be simultaneously lighted in different colors. By increasing the depth of the wall to 24 in., the thresholds between the different colors can be diffused so that contrasting areas of color gently blend into each other. Thus the upper and lower areas can blend on the horizontal plane to increase the effectiveness of sky effects or vertical or block areas can be contrasted for design effect.

When the depth of the Wall is suitable, it is possible to arrange for very striking color shadow effects on the translucent surface. Also, high-intensity, narrow-angle spotlights can be mounted behind the edges of the translucent area in order to act as slashing lights and to superimpose lines of light onto the color-lighted areas.

It is not necessary to dwell on dramatic possibilities of the Wall. The provision of a luminous background that can be adjusted to any color hue at any required brightness offers unique opportunities for the creation of mood values. The color can be varied in front of the camera and can be used to create dramatic and pictorial effects of great value.

Figure 5 depicts a free-standing Century Color Value Wall used by the U.S. Department of Commerce in the TV Color Exhibition in the Tokyo 1957 International Trade Fair.

Wide-Screen Television

By SEYMOUR ROSIN
and MADISON CAWEIN

A television system known as "Scanoscope" has been developed in which the aspect ratio has been changed from the conventional 4 × 3 format into an 8 × 3 presentation. Advantages are analogous to those in wide-screen motion pictures. The process is based on the Scanoscope lens described in the succeeding paper in this Journal. This lens squeezes the image on the camera focal plane, from which it is transmitted with the required megacycle bandwidth. The image is unsqueezed electronically in the monitor. The optical and electronic features are described.

Motion-Picture Wide-Screen History

In recent years, the art of motion-picture portrayal has undergone a revolution. Up to about five years ago, the screen aspect ratio was 4 to 3 and the angular coverage in the horizontal direction was only slightly in excess of that in the vertical. With very few exceptions, however, gravitation forces the scene interest to extend horizontally, whereas the vertical center of interest does not extend nearly so far. One has no interest usually in seeing expanses of the sky above one's head or the ground at one's feet, whereas a lively interest exists in scenes or action lateral to the center or centers of primary interest.

For this general reason, the motion-picture industry has changed the aspect ratio by means of a variety of methods from the former 4 to 3 value to a series of frame ratios ranging from 5 to 3 all the way up to 8 to 3 or more. The success and application of the wide-screen motion picture have been so outstanding that it has achieved complete acceptance by the public and the industry.

Technically, the increase in aspect ratio presented a number of problems which were solved in a variety of ways. The photographic film, being uniform, does not care what the aspect ratio of the image it records actually is, since it is uniform over its extent. However, the optical system, that is to say, the camera and projection lens, definitely does care. These spherical lenses have a definite angle of coverage beyond which the image deteriorates rapidly. This coverage is equal for all orientations, so that the most efficient image is encompassed within a circle. The optically most efficient recording and projecting of motion pictures would therefore be circular. However, this representation would be artistically objectionable and wasteful of film. With straight boundaries, the most efficient aspect ratio would be unity. This efficiency is not much reduced in increasing the aspect ratio from unity to the old standard of 4 to 3, but falls off rapidly at higher aspect ratios.

The means used to live with this lack of optical efficiency are several in nature. They include increasing the scale of representation with larger sizes of film and longer focal-length lenses, sometimes with specially designed wide-angle lenses, or of retaining the scale and cropping the image.

Finally there is the anamorphic process by which a scene of high aspect ratio can be transferred to a focal plane image of low aspect ratio, thereby achieving retention of optical efficiency. This is the basis of the Scanoscope method as used in television.

Scanoscope Wide-Screen Television

If a wide-screen, high aspect ratio is ever to be applied to television for the same compelling reasons as existed in motion pictures, the authors believe this must be done by means of the anamorphic method. The desirability of having a low aspect ratio at the film plane results not only from the optical considerations stated above, but also from electronic ones. Unlike the photographic film which does not care what aspect ratio is used, the round television camera-tube form and the image-scanning process itself both demand a low aspect ratio at the focal plane.

A block diagram of this process is shown in Fig. 1, the details of which will be obvious to members of the Society. Figure 2 shows a standard 4 to 3 aspect-ratio scene. Figure 3 shows a corresponding Scanoscope scene with 8 to 3 aspect ratio. Figure 4 shows the scene of Fig. 3 compressed at the camera focal plane to the low-aspect-ratio (4 to 3) framing of Fig. 2. This compressed or squeezed image is unsqueezed in the receiver circuitry to present the original scene of Fig. 3 to the observer or audience.

Two more points shown in Fig. 1 require further explanation. First, if the wide 8 to 3 scene of Fig. 3 has the same detail as the 4 to 3 scene of Fig. 2, it presents exactly twice the total information to the observer. If in accordance with present standards 4.5-mc bandwidth is considered sufficient to present the detail of Figure 2, 9 mc will be required to present the detail of Fig. 3, assuming the same number of scanning lines and the same frame rate in the two cases. Second, the 8 to 3 receiver screen affords a means of televising wide-screen motion pictures. If squeezed-image-type prints are projected directly into the camera as shown in Fig. 1, they will be correctly displayed to the audience looking at the receiver.

The heart of the Scanoscope system is the Scanoscope lens described in the succeeding paper in this *Journal*. It is important to allay one relatively common misconception in the industry. This misconception is the assumption that the electronics set the limit on detail representation. In point of fact, the reverse is very often true. For example, the RCA 6198 vidicon tube has its 525 lines compressed within an image height of 0.375 in. This implies that each scanning line covers approximately 0.0007 in. in the image plane. A lens is considered very excellent if it has a blur circle of 0.001

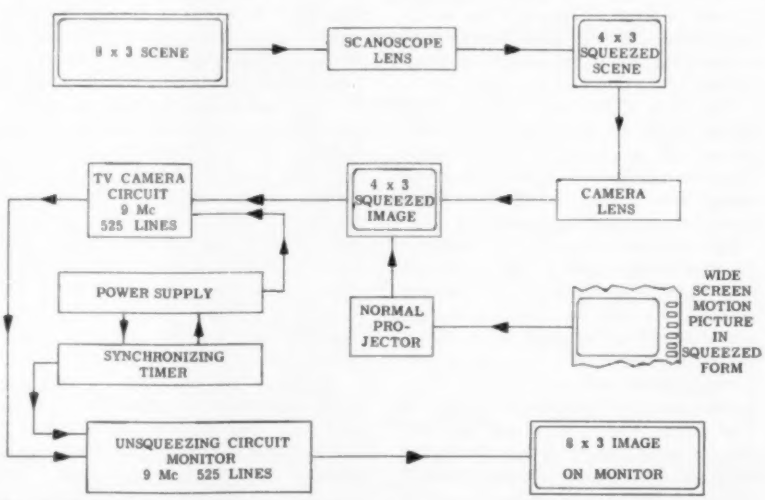


Fig. 1. Block diagram of Scanoscope Process.

Presented on May 2, 1957, at the Society's Convention at Washington, D.C., by Seymour Rosin (who read the paper) and Madison Cawein, Grimson Color, Inc., 381 Fourth Ave., New York 16.
(This paper was received on March 14, 1957.)

Fig. 2. Scene on standard TV screen.

Fig. 3. Same scene on Scanoscope Screen.

Fig. 4. Same scene in squeezed form.

in.* Fortunately the Baltar series (Bausch & Lomb) and the Yvar and Switar series (Paillard) are known by the authors to have resolution capabilities of the order of 0.0005 in. Others must also exist, but they must be carefully chosen.

The Scanoscope lens in conjunction with these standard lenses does not deteriorate the image up to a field angle of the order of 80° or so. If one desires to cover this large horizontal angle, one selects the camera lens normally designed to cover 40°. The Scanoscope lens in front will then give the horizontal 80° coverage. It is interesting to note that a normal camera lens of this large angular coverage will have low edge-to-central illumination ratio due first to severe vignetting and second to operation of the $\cos^4 \alpha$ law of field illumination fall-off. The combination retains the much lower vignetting of the 40° lens, and the $\cos^4 \alpha$ law becomes the much less severe $\cos^2 \alpha \cos^2 \alpha/2$ fall-off law of field illumination.

Closed-circuit systems of the Scanoscope process have been constructed in prototype form and are now being built for various military and closed-circuit industrial purposes. The system has been completely successful and has resulted in presentations of the nature of Fig. 3, with television resolution in excess of 400 lines vertically and as good resolution horizontally. These applications have been made with various camera tubes including the 6198 RCA vidicon, the 600 Diamond Utilicon and the image orthicon (the latter, of course, being to larger scale).

Circuitry

The television circuitry does not involve any unusual features not already incorporated in broadcast studio práctice. The camera scan circuits are normal and retain the 4 to 3 aspect ratio usual in commercial television studios.

It is necessary, however, to provide somewhat better linearity controls of the camera horizontal scan fields due to the fact that there is a 2:1 magnification of the camera image width at the receiver. To achieve the proper result a cathode follower is used to drive the H-deflection coils. The inductive load of the cathode is adjustable, as are the phase of synchronization and the amplitudes of sawtooth and impulse components in the driving voltage waveform. Width control is achieved in a unique manner by adjustment of the capacitance between grid and cathode of the cathode follower.

The 2:1 magnification of the camera image width by the receiver makes it imperative that the camera resolution be twice as good as normal. Assuming that

* Alexander E. Conrady, *Applied Optics and Optical Design*, Oxford Univ. Press, London, 1929, p. 395.

the apertures involved in the scanning process are proper, that is, commensurate with the smallest picture element desired, the first elided frequency of the system is at AN^2F: where A is aspect ratio, N is the number of lines in the unblanked raster and F is frame frequency. RETMA standards are used in the Scanoscope presentation, except for A which is 8 to 3 instead of the usual 4 to 3. The first elided frequency occurs at 23 mc.

If the apertures were compensated to 90% of this band where signal amplitudes fall to zero, a 20-mc video amplifier would be required. Reproduction in the detailed regions of the picture (approximately 500 lines vertical and 1000 lines horizontal) would be correct to within 1 db for 5 contrast steps.

It is usual in TV practice to rate the resolution without gray scale, that is, at a point where one contrast change is observable, requiring two contrast steps, dark and light. It is well known that the information is proportional to the log contrast. Reduction of the contrast requirement at the limit of resolution reduces the required bandwidth by a factor log 5/log 2, so that 9 mc is approximately correct for Scanoscope bandwidth.

The video amplifiers were designed for minimal phase shift, and a minimum number (six in all) were included to reduce overall phase distortion. A conventional high-peaker is included. The bandwidth is flat to 9 mc, and cutoffs are approximately gaussian. Vertical resolution is approximately 400 TV lines, and horizontal is approximately 800, at the center of the picture. This can be achieved with a 6198 or 6326 without dynamic focus circuits. Most television engineers are surprised that this performance is possible. Some pains, however, were taken to center the camera tube and image in the deflection system, and high-quality lenses were used. Complex circuitry was avoided.

Power supplies are conventional. The design of the sync generator achieves true interlace from crystal control, unique count-down circuits, and freedom from hum. At the monitor the horizontal deflection angle which is linearly proportional to H-scan current, unsqueezes the picture in the same way that an anamorphic projection lens would unsqueeze. The display can be made on a 21-in. cathode-ray tube (21ALP4), the normal vertical deflection angle being cut in half to reestablish the 8 to 3 aspect, with resultant dimensions approximately 7.5 in. by 20 in., without any unusual circuits.

Conclusions and General Observations

The Scanoscope Wide Screen Television process has undergone considerable observation and evaluation by the authors for the last eight months or so. Technically, the process is completely successful and ready for use. We believe that almost everywhere that television is being used, Scanoscope will provide more complete and satisfactory presentation. In the military and closed-circuit fields it provides twice the information with essentially the same equipment. In the documentary and entertainment fields it can provide the same advantages that wide-screen motion pictures afford. It provides a means, not now available, to display modern motion pictures on television. No additional problems exist to prevent its use with color.

If one might be permitted, in a technical article, to think of what home television of the future could be, one can visualize one of the "thin receivers" of the type under development at Kaiser Aircraft and Electronics, and possibly at other places, in a fairly large size hanging on the wall and presenting a wide-screen, 8 to 3 picture in color to its audience. Or alternatively, this picture can be projected.

Discussion

Richard H. Ranger (*Rangertone, Inc.*): Although I hate people who say that back 50 years ago, or 20 years ago, they did something of this sort, I must note that actually in 1928 we were sending pictures by radio across the ocean. These were still pictures, and we were trying to work out the method of getting the best detail. We had the normal format to start with and all of our circuits were coming along better and better and so we thought it expedient to use finer definition, horizontally, doing just what you've done, and keeping the vertical as it was. We went through considerable tests with that, but then came to the conclusion, after making unquestionably better pictures that "now we've got better circuits, let's make the definition better both horizontally and vertically and use up our new facility in that direction." And the net result was even better. I just wanted to throw that in as to what we found at that time. In other words, isn't there perhaps — and haven't we had it in CinemaScope — the same sort of thing — in other words, the spreading out does not necessarily give the eye more grasping of information by that process; isn't the complete square where every little dot has its vertical and horizontal definition — the best possible — isn't that perhaps the best answer?

Mr. Rosin: It seems just as much an artistic question as a technical question; but we would not agree with you. We've had a chance to observe our system for the last six or eight months and every time we go back and look at our old television set we're dissatisfied.

Ralph N. Harmon (*Westinghouse Broadcasting Co.*): I believe it is true that, with your 9-mc and with your 525-line system, your vertical and your horizontal resolution are approximately the same. In other words, they're back to the present standard 4:3, i.e. approximately equal resolution in the horizontal and the vertical. Without trying to invent into your system something that would give you this resolution, there are, as we all know, ways to get around this by sacrificing some other feature. You could go to a line interlace. In other words, you could skip every other picture element of the individual line on each field scanned and, as a result, take twice as long (twice as many fields) to get a complete picture, and then you'd get back your original horizontal and vertical resolution ratios that we now have, with twice as wide a picture.

Mr. Rosin: That is true; however, we felt that in introducing Scanoscope to anyone at all we should have a picture that's equivalent to the present picture for it to be accepted. Now, it is possible that we can back off either by decreasing the number of lines, which we'd hate to do, or by decreasing the scanning rate.

Mr. Harmon: Then I think maybe I would go along with Col. Ranger in that, if you're going to transmit this over a 4½-megacycle system, you'd have to agree that your horizontal resolution would, perhaps, be too low by a factor of 2 to 1. And maybe with that you wouldn't really win anything after all; but if you actually had your 9 mc, we would agree that this would be better than the 4 to 3 aspect ratio with the more or less equal horizontal and vertical resolution. What I was really suggesting was that perhaps a compromise on it would be to take fewer complete pictures per second and still have more or less equal horizontal and vertical resolution by using dot interlace along the line.

Mr. Rosin: That is certainly a possibility and we could get the Scanoscope picture within 4½ mc, with the lower scanning rate.

Mr. Harmon: It should be noted that for a closed-circuit television, this system takes advantage of what the closed circuit can give, without going to a lot of new elaborate scanning equipment, etc.

Anamorphic Lens System

By SEYMOUR ROSIN

An anamorphic lens known as "Scanoscope" has been developed for use in motion pictures and television. The optical design is described, showing how the aberrations are controlled over a field angle of 80° or more. A unique coupling arrangement allows this lens to be used interchangeably with camera lenses of different focal length in a unit focus arrangement. Application of this system to the Mitchell NC and BNC cameras is described.

THE PRESENT article describes an anamorphic lens system known as "Scanoscope" for the purpose of taking wide-screen motion pictures. Optically the method is based upon Chretien's* original work in this type of system; the anamorphic process has had considerable commercial success in the industry. However, the Scanoscope System employs optical and mechanical features which are unique and which will be discussed in this paper.

I. The Optics

The optics of motion-picture anamorphic systems and other systems are basically the same. The normal camera lens is used to focus the image on the film plane. In front of this lens is placed the anamorphic combination of cylindrical lenses which squeezes the image into its framing proportions before being focused on the film plane by the camera lens. A block diagram is shown as Fig. 1. After the film is suitably processed, it is projected through a similar optical system to give a faithful rendition of the original wide horizontal presentation.

Let us now consider the ray diagram which is shown in Fig. 2 for an object at infinity. Figure 2 shows the general arrangement of the Scanoscope optics disposed in front of a 40mm camera lens. As may be inferred from the diagram, the lens has no effect on the rays in the vertical plane, and in the horizontal plane the lens acts as a reversed Galilean telescope of ½ power. Lens B corresponds to the positive objective of this telescope and lens group A to the negative eyepiece. The aperture stop of this telescope coincides with the entrance pupil of the camera lens, and the spreading of the angular field rays demands that the negative lens group B, while having only half the focal length of objective A, must have a much larger physical size. This combination of large physical size and short focal length imposes the chief design limitation on the optics.

In approaching the optical design of the Scanoscope System, it was decided to make the system as light and compact as possible, consistent with the design requirements. These latter envisaged the use of the same Scanoscope lens with the standard motion-picture camera lenses of 40mm, 50mm, 75mm and 100mm E.F.L. For compactness, the focal length of lens B had to be chosen as short as possible. Conversely, the physical size of B had to be large enough to pass a bundle of rays of sufficient size to allow the 100mm camera lens to use an opening of $f/2.8$ and the others $f/2.3$ or better.

Also, for full color correction of the system, it is absolutely necessary that A and B be separately color corrected. These requirements set a practical lower limit on the focal length of lens B and this value was adopted. Since this also determined the focal length of lens group A (half of B), and since the spreading of the rays dictated a large size for A, it became apparent that it would be necessary to split the negative power of A into at least two components. The positive component of A was combined with one of these as shown, and the singlet negative component was placed on the outside to keep the spreading of the rays to a minimum inside the lens.

A third-order Seidel analysis of this system indicated the need for an air space inside the lens group A and further indicated that the system could have excellent correction for the desired specifications and be able to cover an angle of approximately 80° in the object space. Further mathematical analysis showed that nothing could be gained by adding more elements to the system and that the high angular coverage could only be increased through the use of aspheric cylindrical elements. Since the procedure of producing these surfaces with high accuracy seems to be beyond the limits of present-day technology, this possibility was not pursued.

As a result of these considerations, the Scanoscope lens has been designed to give excellent definition over a larger angular field and with a smaller envelope than now exist in designs known to the author.

Presented on May 3, 1957, at the Society's Convention at Washington, D.C., by Seymour Rosin, Scanoptic, Inc., 381 Fourth Ave., New York 16.
(Final paper was received on April 22, 1957.)

* U. S. Pat. 1,962,892, June 12, 1934.

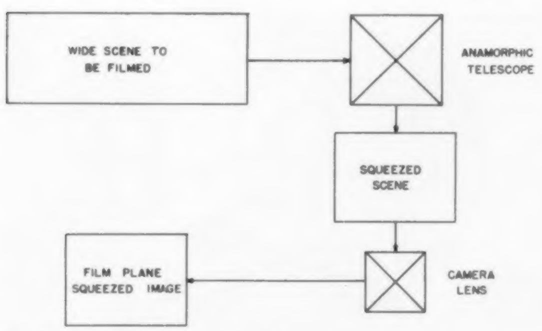


Fig. 1. Block diagram, anamorphic process.

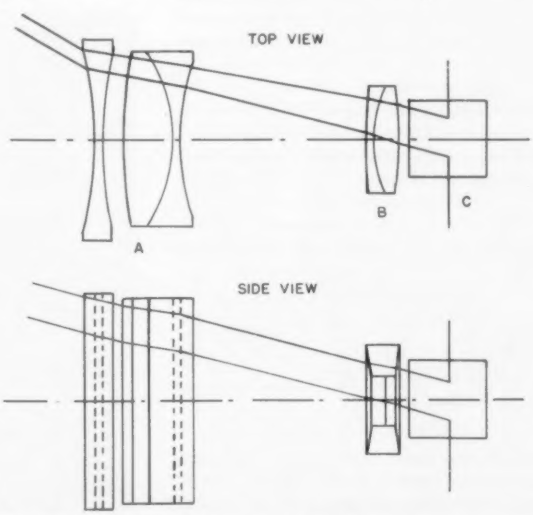


Fig. 2. Schematic optical layout and ray diagram.

Fig. 3. Conjugate point diagram.

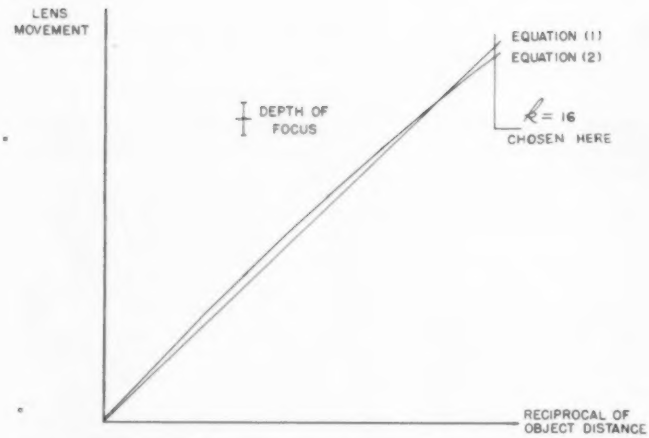


Fig. 4. Focusing functions for camera lens (1) and anamorphic telescope (2).

II. Focus Arrangement

When focusing for near objects, the camera lens must be shifted away from the focal plane by an amount dependent on the distance of the object and the focal length of the lens. This is given by the Newtonian relation:

$$x'_C = -f_C^2/x_C \qquad (1)$$

where x' is the shift, f_C is the focal length of the lens and x_C is the distance of the front focal point of the lens from the object.

The anamorphic lens, composed as it is, must also be focused for near objects. This will involve a shift of lens group A (negative) toward lens B (Fig. 2) by an amount which depends on the closeness of the object.

Figure 3 shows again the cylindrical-lens groups A and B, and for an anamorphic factor of $\frac{1}{2}$, $f_A = -\frac{1}{2}f_B$. M represents the position of the near object, and M′, its image as formed by A. This serves as object for B, which reforms the image back at M. Thus the object at M is not displaced through the cylindrical system and is presented, unaltered in position, to the camera lens C.

Since the image presented to the camera lens is at the position M for both meridians, the cylindrical groups A and B form a truly anamorphic combination, and we will refer to it hereafter as "the anamorphic telescope."

Expressing this nonalteration of the object mathematically and eliminating unneeded variables, we obtain

$$u_A^2(f_B - u'_B) = -u'^2_B(f_A + u_A)$$

where u_A = AM = Object distance for lens group A, and u'_B = BM = Image distance for lens group B.

If, further, we set

$$d_0 = f_B + f_A = fB/2$$

which represents the optical separation at infinity focus of lens groups A and B, and express the position of M in terms of this separation

$$u'_B = -kd_0$$

and noting that

$$u_A = d + u'_B$$

where d is the separation of lens groups A and B for any general separation and if, finally, we set $x' = d_0 - d$, we obtain through algebraic manipulation the quadratic equation

$$(k+2)\,x'^2 + (k^2 + 2k - 4)\,d_0x' - (3k-2)\,d_0^2 = 0 \qquad (2)$$

Binomial expansion of the general solution of this equation indicates that for k reasonably large, x' varies inversely with k. The approximation is fairly close for $k = 16$ or larger, as may be seen from Fig. 4.

This close approximation to an inverse linear function for both camera lens and anamorphic combination is to be expected since all optical focusing is of this nature where the object distance is large compared to the focal length of the focusing elements.

III. The Mechanical Arrangement

In approaching the mechanical design of the anamorphic system, composed of the $\frac{1}{2}\times$ anamorphic telescope and the associated camera lens, the designers of Scanoptic, Inc., set forth the following specifications:

(1) The anamorphic telescope and the camera lens must be considered as a single centered optical system and must therefore be mounted in a unitary housing centered with regard to the aperture plate of the camera.

(2) For close focusing, the separate focusing adjustments of the camera lens and of the anamorphic telescope must be effected by a single unitary rotary motion, capable of simple coupling with the follow-focus attachment of the camera. The diaphragm adjustment must be readily accessible.

(3) The relatively expensive anamorphic telescope must be detachable from its assembly with any particular camera lens and capable of being quickly and conveniently attached to another of different focal length.

(4) The anamorphic combinations must cover the use of the anamorphic telescope with the standard motion-picture lenses of 40mm, 50mm, 75mm and 100mm focal length.

In order to fulfill these specifications, it is necessary to correlate the different-focal-length camera-lens motions with that of the anamorphic telescope. Equation (1) shows a strict inverse relationship for focusing with respect to the front focal point of the camera lenses. Equation (2) shows a very closely inverse focusing relationship with respect to the object distance measured from lens group B (Fig. 2) of the anamorphic telescope. Lens group B is placed physically quite close to the front focal point of the associated camera lens.

Fig. 5. Component parts, Scanoscope system.

Fig. 6. Scanoscope mounted on Mitchell NC Camera.

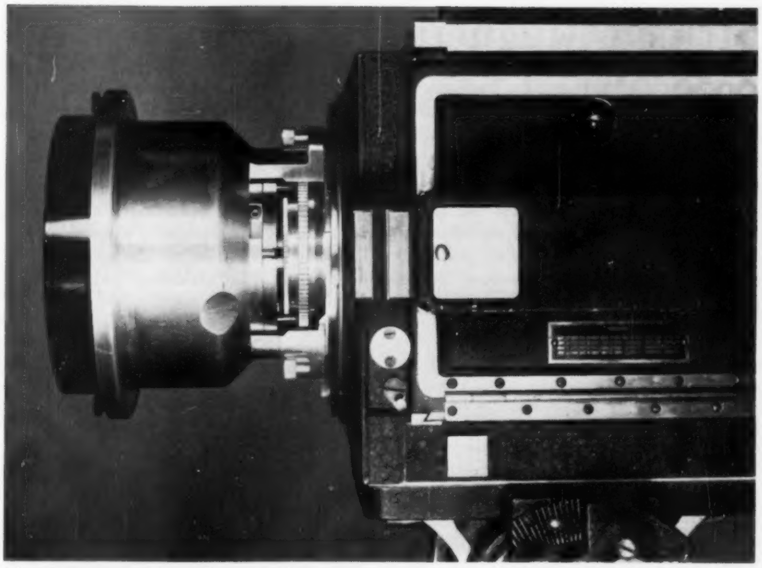


Fig. 7. Close-up view of mechanism.

The specifications set forth above envisage the employment of different camera lenses with the same anamorphic telescope. This means that the rotary motion of the camera lenses must all be the same for equal object distances. Since the proper optical point from which the object distance must be measured is the front focal point as explained above, their motion is described by Eq. (1). Suppose, then, we choose the rotary motion of the 50mm lens to be governed by 9 threads/in. Then the other focal lengths, in accordance with Eq. (1), will be:

100mm lens	–	2.250 threads/in.
75mm "	–	4.000 "
50mm "	–	9.000 "
40mm "	–	14.062 "

If these values are chosen, the camera lenses will travel for focusing along the straight line of the graph in Fig. 4. At the same time, the focusing of the anamorphic telescope also governed by a straight helix will travel (in accordance with Eq. (2)) along the curved line of the graph. It will be noted that at any point the discrepancies of the curves are only a fraction of the depth of focus of the anamorphic telescope. Furthermore, it is undoubtedly much better to tolerate these discrepancies than the machining errors that might result if it were attempted to match the curves more exactly by some nonlinear type of drive for the anamorphic telescope.

The preceding discussion shows that it is possible to correlate the motion of the anamorphic telescope, with its relatively large depth of focus, to the different camera lenses. These latter have, as is well known, a very small depth of focus in the image space. Since the actual camera-lens focal lengths are never quite equal to their nominal value and since the object distance is usually measured from the film plane and not from the front focal point, there is no reason why the camera-lens distance scale should not continue to be calibrated in the usual way, by means of a fixture used on the camera lens itself and referred to the film plane. Since the correlation of the motions is quite close, well within the range of focus of the anamorphic telescope, the calibration of the camera lens in the usual manner will give precise focusing for the combination.

The construction of the Scanoscope system may best be illustrated by a series of photographs showing its mounting on a Mitchell NC camera. Figure 5 shows the component parts of the system, including the anamorphic telescope, the four standard camera lenses mentioned earlier, with focusing threads according to the tabulation above and with the coupling pins clearly visible projecting from each of the camera lenses. Also visible are the drawings showing the arrangement of the anamorphic telescope with the 40mm and the 50mm camera lenses.

Figure 6 shows the 50mm assembly mounted on the front of the Mitchell camera, with the 40mm lens on the turret ready for quick assembly when needed. All that is necessary is to disconnect two thumb-screws, swing the 40mm lens into position and recouple.

Figure 7 shows a few of the details. The focusing scale is seen at the right. The gear for attachment to the follow-focus device is visible just to the left of the footage scale. The coupling pins are seen projecting into the modified Oldham coupling permanently attached to the anamorphic telescope. At top and bottom are the thumbscrews mentioned in the preceding paragraph. Between the coupling pins is seen the diaphragm scale which may be adjusted for proper aperture setting.

The whole arrangement described here makes for a compact and convenient system for taking anamorphic pictures. The fact that the camera-lens scales are so nearly alike presents obvious advantages. One of these may be mentioned. The parallax cam which actuates the viewfinder on the Mitchell camera is theoretically the same for all the different focal lengths down to an object distance of 5 ft or so, and there is no need to change viewfinder cams for different-focal-length camera lenses.

Test and commercial pictures taken with the Scanoscope system have been uniformly excellent.

We wish to thank Camera Equipment Co. for the excellent work done on the machining of the camera-lens mounts and for their generous cooperation throughout the project.

Striped Magnetic Sound in CBS Television News Production

By R. C. RHEINECK

Prestriped magnetic sound on 16mm film as compared to 16mm single-system photographic sound provides the quality advantages of an extended high-frequency response, improved signal-to-noise ratio and lower harmonic distortion. Operating experiences with striped magnetic sound in relation to film striping, camera photography, laboratory processing, editing, film cleaning, printing, projection and library storage are described.

A FILM STORY for a television news program must be available within the shortest possible time or its value is lost. Time in television news production is measured in minutes and it is not uncommon to have film material processed and edited for "Air" use in less than an hour. Film production conditions are normally far from ideal. News events occur at any time and in any place; time available for equipment setup is limited; lighting is restricted, if available at all; acoustics of a given location are fixed and no corrections can be made.

The time limitations together with the required portability of equipment have determined the general choice of 16mm film for television news production. These same factors have determined the choice of single-system rather than double-system sound. Having selected the best available means of working within the time requirements and employing all available methods of shortening laboratory processing and film-editing operations, it is possible to produce a film product within an acceptable time limit. The quality of the product, however, often leaves something to be desired.

Television news, unlike its theatrical counterpart, is not a complete film package within itself. Instead, it is continually subjected to direct comparison with "live" programming (i.e. news commentator) and is preceded and followed either by "live" programming or by a film product produced under the best possible conditions. Considering that an average network television news program is viewed by more than twelve million people, most of whom are accustomed to the high-quality sound of radio news, the quality of sound-on-film becomes an important consideration. We know that relatively poor picture material will be acceptable to the average viewer if the accompanying sound is intelligible and of the best possible quality. We also know that the converse is true in that the average viewer becomes critical of picture material when it is accompanied by poor-quality, unintelligible sound.

Sixteen-millimeter single-system photographic sound is, at best, just about acceptable. The required use of a film product not designed for sound recording and the compromise between sound and picture quality in processing present inherent limitations as to the maximum standard of sound quality which can be achieved. These limitations have long been recognized. The advantages of magnetic sound in extended high-frequency response, marked improvement in signal-to-noise ratio and lower harmonic distortion are also well known. An equal or even more important advantage is the ability to monitor magnetic sound as it is produced, thereby insuring the presence of the sound record.

For these reasons, CBS News began an engineering program in 1955 to evaluate the problems in the use of prestriped magnetic sound for 16mm television news and documentary film production. By "prestriping" is meant the application of the magnetic material to the film prior to exposure and development. In the past six months this magnetic-sound procedure has been employed for some of these types of production at CBS. Our engineering program included the evaluation of problems in such phases of striped magnetic sound production as raw-stock film striping, camera photography, laboratory processing, editing, film cleaning, projection, printing and raw-stock and library storage. A brief summary description relating to each of these phases is included here.

Raw-Stock Film Striping

Magnetic striping of developed photographic film has been commercially available for more than five years. The ASA Standard relating to the dimensions of the 100-mil coating was approved in 1953 (PH 22.87). In order to utilize prestriped magnetic sound, it is necessary to adapt the striping technique to operate in photographic safelight illumination or in "total darkness." Commercially available black-and-white as well as color film products have been satisfactorily prestriped. In general, all photographic materials can be striped providing the applicating equipment is designed for operation under the required darkroom conditions. The potential problem in the utilization of prestriped film is not found in the striping operation but rather in the processing. This problem is discussed later.

Both the laminated and wet types of prestriped magnetic material have been used in our operation with satisfactory results. Evaluation of photographic characteristics of the negative raw stock for contrast, speed sensitivity and fog susceptibility indicates no evidence of any effect. Physical characteristics have also been evaluated and there is no evidence of rubs, abrasions, sensitized or desensitized defects, dirt or scratches. Quality of the magnetic stripe has been successfully controlled by the manufacturer by such means as the recording of a frequency signal on the stripe as it is applied to the film. This signal is monitored and then erased.

In addition to prestriping of negative raw-stock film on the base side, a negative–positive operation where contact printing is used requires prestriping of the positive raw-stock film on the emulsion side. In this way, either the negative or a contact print from the negative can be reproduced on the same magnetic head of a projector. The laminated-type magnetic stripe on the emulsion side has been successfully employed in our operation. The use of the wet-type magnetic stripe on the emulsion side is not at present satisfactory because of a processing problem. The manufacturer is continuing investigations relating to this and we believe that this method will also prove satisfactory.

One unresolved question pertains to the value of the 30-mil balance stripe on the outside of the perforated film edge. An SMPTE Recommended Practice for magnetic striping notes that the balance stripe is optional and may be a magnetic coating or another material of the same thickness. There are presently two schools of thought relating to this question. One maintains that the absence of the balance stripe will result in the tendency of the film base to distort from the unequal pressures on the two edges and adversely affect the recording-head contact with the magnetic stripe. The other maintains that the use of the balance stripe will result in the tendency of the film base to distort in the center and adversely affect picture sharpness either in photography or on projection. We are using material both with and without a balance stripe and have not experienced either of these

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two types of defect. From the standpoint of ease in handling and to avoid "dished" rolls, a balance stripe is a definite advantage, particularly with roll lengths of over 400 ft. We believe further operating experience with both types of material is required before a definite conclusion can be reached.

The increase of the film-roll diameter with the addition of the magnetic stripe has also been evaluated. The average thickness of either the wet or laminated stripe is approximately 10% (0.6 mil) of the average overall film thickness. The diameter of 400-ft and 1200-ft rolls of raw stock is increased by approximately 5% with the addition of the stripe. Film magazines for 16mm cameras, in general, provide a greater tolerance for roll diameter than this 5% average. It is conceivable, however, that a problem will exist when film magazines of certain manufacture are employed with film of maximum thickness which has a magnetic stripe of maximum thickness. While we have not experienced this difficulty, we believe the design of new equipment should consider the desirability of increasing this magazine dimension to provide adequate clearance for striped material.

Camera Photography

In introducing the technique of striped magnetic sound recording into an operating program, the desirability of not interrupting the program must be considered. For this reason, a camera conversion which provided the means of producing both photographic and magnetic sound interchangeably was selected. The "Filmagnetic" design for the Auricon 16mm cameras as provided by Berndt-Bach, Inc., and which we first tested in 1955, has proven satisfactory in our program. This equipment was described in a paper presented before the Society in 1956.* This conversion allows us to utilize existing equipment for photographic single-system sound production as well as for the improved-quality striped magnetic sound production.

With the use of striped film in a camera, the possibility of excessive magnetic head wear and/or wear of various camera parts by abrasive action of the magnetic oxide is being carefully watched. Cameras are periodically checked by the recording of a test signal of 7000 cycles and all camera parts within the film path are inspected. After operation with over 100,000 ft of striped magnetic material with a specific camera, the frequency tests indicate no substantial change in response and there is no evidence of wear at the film gate or at any other part of the camera. If after extended use there is any evidence of wear, the improved quality of the magnetic sound will, in our opinion, justify the small replacement or repair cost.

The presence of the magnetic stripe on the base side of the negative film material does not adversely affect the flatness of the film plane at the camera aperture. The camera pressure plate is spring loaded and successfully positions the film to avoid any resolution loss. Resolution-chart tests comparing film with no stripe and prestriped film have shown no measurable difference. The lens used in these tests was set at the maximum iris opening to provide a minimum depth of focus.

In addition to the improved quality of striped magnetic sound, the use of this recording technique provides a distinct operational advantage in the ability to monitor a sound record as it is produced. This allows for adjustment of certain sound problems during a recording and, most important, equipment failures are immediately evident.

Processing

Both the wet and laminated types of prestriped negative film have been processed in immersion and spray types of developing machines. There has been no evidence of any adverse effect on the magnetic stripe, the picture area of the film, the processing machine or the developing solutions. In a specific test, 9600 ft of striped material were processed on a spray-type machine with solution temperatures maintained at 80 F. Sensitometric strips at the beginning and the end of the 9600-ft as well as between each 1200-ft roll indicated no measurable difference in gamma, density or chemical fog level. Developer samples were analyzed before and after processing with no evidence of any change. Solution filters were examined before and after processing with no evidence of any contamination.

The manufacturers of magnetic material have attributed this freedom from detrimental effect to the virtually inert binder material which covers each oxide particle and to the fact that the magnetic material is the completely oxidized and most stable form of iron oxide. A similar quantity of prestriped positive film with the stripe on the emulsion side has also been processed under the same controlled conditions. The results in this case were identical with those in the test of the negative material. In the case of the positive material, the laminated magnetic stripe apparently seals off the photographic emulsion from any action by the processing solutions.

Negative and positive films are employed in our operation, but our experience with reversal film stocks is limited. However, reversal film with a magnetic stripe has been satisfactorily processed. A normal reversal processing procedure does not employ any solvents which will adversely affect the magnetic stripe and we do not believe that any processing problems will be encountered. Our experience with photographic materials which employ the type of antihalation backing which is removable in processing is also limited. We are currently conducting investigations which we believe will indicate that processing of such film can be accomplished satisfactorily. We base this belief on the assumption that the magnetic-stripe material will seal off the backing in the same manner as that which has been evident in processing of positive material with the stripe on the emulsion side.

Editing

Editing of full-coated magnetic film has been a successful operation for a number of years. Editing personnel are experienced with the procedures, and striped magnetic material presents no new complications. Commercially available film viewers, splicers, splicing cements and magnetic sound readers are satisfactory for operation with striped magnetic film. Synchronizers and footage counters equipped with magnetic reproduction heads are now available.

Sixteen-millimeter review-type projectors which provide for the reproduction of striped magnetic sound are available. The semiprofessional projectors of this group leave something to be desired from the standpoint of quality evaluation. These projectors are, in general, not capable of reproducing the full frequency range of striped magnetic sound and the film motion introduces a high percentage of wow and flutter. If professional projectors like the Bell & Howell "JAN" or the Eastman Model 25 are available for quality evaluation, the semiprofessional projectors can be utilized for the editing operation. The magnetic sound reproduction feature is commercially available on the Bell & Howell "JAN" projector. A developmental model of a magnetic sound reproduction attachment for the Eastman Model 25 projector has proven satisfactory in our evaluation and it is hoped that such an attachment will be commercially available in the near future.

Striped magnetic sound provides a distinct editing advantage as compared to single-system photographic sound. In editing news film it is frequently necessary or desirous to retain certain picture material. Because of the 26-frame photographic sound advance, unwanted sound material is also included. There is no practical means of quickly removing this photographic record. With magnetic sound, this portion can be quickly and easily deleted by a simple erasure procedure.

There is an additional potential editing advantage in the use of striped magnetic

* Walter Bach, E. M. Berndt, A. N. Brown and R. L. George, "Magnetic 16mm single-system sound-on-film recording camera equipment," *Jour. SMPTE, 65:* 603–605, Nov. 1956.

sound with such equipment as the "Sync Point Shifter," as described by Mr. D'Arcy at the Society's Convention in New York during May, 1956. At least one other manufacturer is reportedly working on the design of equipment to perform a similar function. With such a specialized equipment item the magnetic sound record can be transferred to a point directly opposite the corresponding picture frame. While this procedure provides something less than the complete flexibility available in double-system editing, it does offer a definite advantage as compared to that available with single-system photographic material. After editing, this same equipment can be utilized to restore the 28-frame magnetic sound advance for projection. Equipment of this nature can be designed to operate at speeds two or more times that of the standard 36-ft/min operating speed of a sound recorder. Equalization and other sound quality corrective measures can also be incorporated.

Film Cleaning

The binding materials employed in the manufacture of the magnetic stripe are soluble in various chemical solutions. With certain film cleaners it is possible to damage or even completely remove a magnetic stripe. This problem will be encountered if the solvent of the film cleaner is the same as that employed in the manufacture of the magnetic material. Trichlorotrifluoroethane, which is commercially available from Du Pont as Freon 113, has been found to have no detrimental effect on either the wet or the laminated stripe. The film-cleaning abilities of Freon 113 are relatively well known and have been covered in papers presented before the Society.

Television Projection

At least two manufacturers of 16mm television projectors have offered the magnetic sound reproduction feature for some time. Unfortunately as far as the use of striped sound is concerned, these makes of projectors are not predominantly in use at television stations. However, the two manufacturers of the 16mm projectors which are in use in the largest number of stations have completed experimental models of magnetic sound reproduction attachments for their equipment. Evaluation of this equipment has been completed for one projector and will soon be for the other. We hope that commercial models of these attachments will be available during 1957.

In our operation with magnetic sound, we have employed the developmental model of the magnetic sound reproduction attachment for the Eastman Model 250 television projector. A complete report on the installation and performance of this equipment is too lengthy to be included here. In brief, we have found the performance of this attachment to be completely satisfactory. With this developmental model, the operational selection of magnetic or photographic sound requires only the positioning or lifting of the magnetic head by means of a lever and the selection of the desired pre-amplification characteristic by means of a switch.

Printing

With presently available equipment, it is possible to produce prints from original negative with striped magnetic sound. These prints can be produced with either magnetic or photographic sound. The photographic sound can be either a direct positive recording or a photographic print from a re-recorded negative soundtrack. This operation requires the use of recording equipment in a double-system type of production which is too time-consuming to be practical in general television news work.

To overcome this time obstacle a special magnetic sound to magnetic sound reproducer attachment has been added to a Bell & Howell Model "J" 16mm printing machine. This attachment, designed and fabricated by Bell & Howell at our request, provides the means for producing prints with striped magnetic sound from magnetic sound on the original negative in a single-system type of operation. The equipment is capable of reproducing sound with no apparent loss in frequency range or signal-to-noise ratio and without the introduction of wow and flutter disturbance or distortion.

A further step, now in design, is the addition of a direct-positive photographic modulator to this printing machine. With this addition the same machine will be capable of providing either magnetic or photographic sound on prints within the same time as is now required in a complete photographic single-system production operation. Both magnetic and photographic sound for prints will, in our opinion, be required for an interim period until the magnetic sound reproduction feature for all television projectors is commercially available and in general use.

The question of resolution loss in the contact printing of the photographic picture due to the presence of the magnetic stripe on the emulsion side has also been investigated. We have found no significant resolution loss along the picture edge adjacent to the magnetic stripe. Tests indicate that the change in resolution is more greatly affected by variation in the tension adjustment at the printer gate than by the presence of the magnetic stripe.

Raw-Stock and Library Storage

A final consideration, before adopting striped magnetic sound in our operation, was the question of storage effects of striped magnetic materials. To determine the effect of the stripe on shelf life of raw-stock film and possible problems in library storage of developed film, a series of accelerated aging tests were conducted with the cooperation of Du Pont's Photo Products Dept. These tests, of the type normally conducted by film manufacturers to determine the aging characteristics of their products, consisted of storing the material under controlled 120 F temperature and 15% relative humidity conditions for one week. This storage period is estimated to be sufficiently severe to provide satisfactory data for reaching a conclusion as to storage limitations and potential problems.

The aged materials, with appropriate controls, were evaluated for photographic characteristics of contrast, speed sensitivity and fog susceptibility as well as for such potential problems as picture-image fading, physical film distortion resulting in unsatisfactory sound due to poor head contact or unsatisfactory picture due to film jump or weave, interreaction between the magnetic oxide and any silver or complex silver salts within the photographic emulsion, separation of the magnetic stripe from the photographic material and print-through of the magnetic sound. There was no evidence of any detrimental effects on either the raw stock or the developed material. From these tests we have concluded that the normal shelf life of raw-stock film and normal library storage periods for developed film are unaffected by a magnetic stripe.

Conclusion

We believe the quality improvements and operational advantages available with prestriped magnetic sound are substantial for 16mm TV news and documentary-type film production. The extended high-frequency response, marked improvement in signal-to-noise ratio and lower harmonic distortion provide quality which is almost equivalent to "live" sound. The operational advantage of monitoring a sound record as it is produced combined with the potential of reduced equipment size and weight are definite advantages in contending with the production conditions encountered in a TV news operation. The basic tools required for prestriped magnetic sound production are available now or will be shortly. In our operation the transition from photographic single-system production to striped magnetic sound production is a relatively slow program. CBS news programs are not as yet completely utilizing magnetic sound. The percentage of use is, however, increasing. We respectfully submit our prediction that single-system photographic sound will give way to the improved production medium of prestriped magnetic sound.

Bibliography

"Symposium on magnetic striping of film," *Jour. SMPTE, 60:* 453–534, Part II, Apr. 1953.

Richard F. Dubbe, "Recent developments in magnetic striping by the lamination process," *Jour. SMPTE, 64:* 378–379, July 1955.
Edward Schmidt, "Laboratory 16mm striping unit," *Jour. SMPTE, 64:* 375–377, July 1955.
Ralph H. Talbot, "Lubrication of 16mm films," *Jour. SMPE, 53:* 285–292, Sept. 1949.

Discussion

Christopher H. Lankester (United Nations, New York): At the Convention a year ago, during the panel discussion on this subject, there was raised the question of splicing prestriped film. The idea was that, owing to the solubility of the coating by the film cement, it would lead to a smearing of the image. Have you satisfactorily solved that problem?

Mr. Rheineck: We've had no problems with splicing. You do, of course, remove the magnetic stripe from the overlapped area on the base side of the negative film. With normal techniques where a proper amount of cement is applied, there are no splicing difficulties.

Mr. Lankester: In the test film which you showed there seemed to be one splice where there was slight smearing, but nothing serious.

Mr. Rheineck: That's quite possible. Splicing techniques are not always perfect, even with film which does not have a negative stripe.

Ellis W. D'Arcy (Session Chairman): That was a print wasn't it, a print of the original? I don't think that was emphasized before.

Mr. Rheineck: Yes. The print material was prestriped. The picture was contact printed and the magnetic sound was electrically transferred on the same printer — in a one-pass operation.

Lawrence F. Brunswick (Bardwell & McAllister): Do you have any experience regarding the successful processing of color material that has been prestriped?

Mr. Rheineck: We have had certain color products processed. We're working on others now, particularly the ones with the antihalation backing which is removable in processing. While we have no demonstration film to show, we feel very strongly that prestriped color films can be satisfactorily processed.

Rodger J. Ross (Canadian Broadcasting Corp.): You mentioned in your paper that you used an attachment for the printer to make an optical transfer in printing. Did you mean that you'd contact print the single-system track or would you make an electrical printing of magnetic track?

Mr. Rheineck: That would be an electrical transfer. The printer is equipped with a magnetic reproduce head on the negative side and a magnetic record head on the positive side. We are now adding to the positive side a direct-positive modulator for recording photographic sound. We will "pick up" the magnetic negative track and electrically transfer to a photographic track. This is for release-print operation where magnetic adaptions for television projectors are not immediately available.

A New Automatic Iris Control for Motion-Picture Cameras

By MERVIN W. LA RUE, JR.

The Bell & Howell Company's new Design 200-EE camera incorporates a self-powered compact automatic iris control. Mechanical power to drive the lens iris originates from a small direct-current, permanent-magnet motor driven by mercury batteries. A photovoltaic cell deflects a relay meter according to average scene brightness, and opening or closing the motor-battery circuit causes the lens iris to be properly positioned. The camera and its method of use are described.

The Bell & Howell Design 200-EE camera was the result of a determined effort to simplify movie making to as great an extent as possible. We tried to appeal to those people who either disliked or were afraid of the mechanics of photography, but who still wanted the end results. Three elements were felt to be basic to the desired simplification: ease of loading, minimizing the need for lens-focusing adjustments, and eliminating the complex process of measuring subject brightness and calculating the proper iris setting. The first of these resulted in the choice of a magazine-loading camera, the second in the design of a new lens with considerably improved depth of field, and the last in the development of the fully automatic iris control which is the subject of this paper.

The author gratefully acknowledges the substantial contributions made by W. W. Wightman to the basic engineering of the automatic iris control, and by P. J. Richartz to the production design of the complete camera.

Presented on May 3, 1957, at the Society's Convention at Washington, D. C., by Mervin W. La Rue, Jr., Bell & Howell Co., 7100 McCormick Rd., Chicago 45.
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Means of Control Selected

The method of automatically regulating film exposure which was felt to be most promising used a permanent-magnet motor powered by two sets of dry cells. The circuit was so arranged that a single-pole, double-throw switch caused the motor to drive in either direction, depending on which side of the switch was closed. The switch was a galvanometer needle trapped between two contacts with the galvanometer being deflected by a photovoltaic cell.

In such an arrangement, if the contacts are linked to the lens iris and both are then driven by the motor, a particular value of photocell illumination will result in the lens iris being driven to some unique position. By proper matching of the photocell, meter deflection, lens iris and linkage characteristics, the iris opening can be made proper for whatever subject brightness is illuminating the photocell. An electrical schematic of this system is shown in Fig. 1. The direction of rotation of the permanent-magnet motor is determined by which of the two batteries the galvanometer causes it to be connected across.

Before going further into the mechanics of the system, it is desirable to discuss ways and means of adjusting for film sensitivity and camera speed, since the method selected has a profound effect upon the engineering of the system.

Sensitivity Adjustment

The relationship between iris-ring rotation and the resultant iris-opening area is essentially a logarithmic function in most lenses. More specifically, a change in exposure of one *f*-stop requires the same amount of angular iris-ring movement throughout the entire range of the iris. Such an iris is called "linear," though this appears to be a misnomer. One means of adjustment which this suggests is a coupling which would bias the iris ring by some constant amount. For example, in order to accommodate an emulsion speed twice as fast as that for which the control is calibrated, the coupling would be adjusted so as to close the iris down by one lens stop. All settings made by the automatic control would then be one *f*-stop smaller, thus properly compensating for the higher film speed.

Other methods are, of course, available. Masking of the photocell, for example, is a usable method if properly designed; however, this possibility was discarded since it involved matching the lens iris to an arbitrary curve by cut-and-try methods. Not only was the time for such a procedure begrudged, but it appeared to be a backward step inasmuch as the design of a linear iris was already available.

Each suggested new means of biasing the system ultimately led back to the adjustable coupling first proposed, though

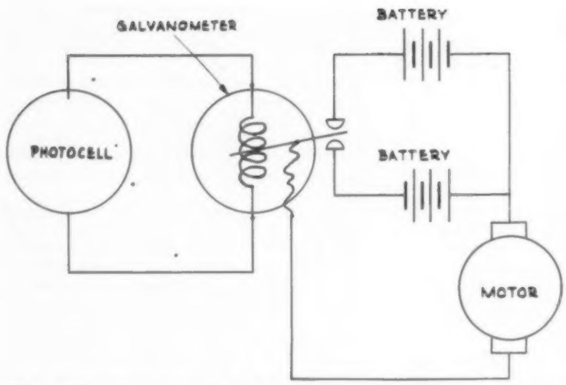

Fig. 1. Electrical schematic of system for automatic film-exposure regulation.

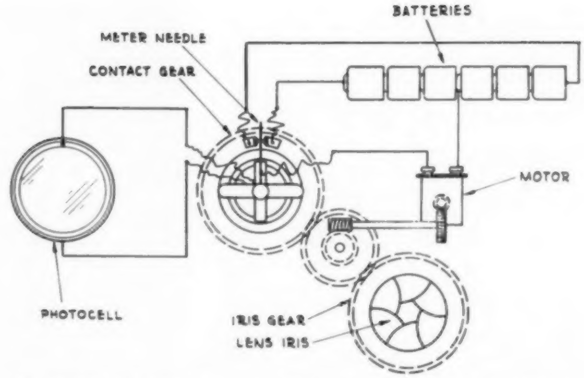

Fig. 2. Mechanical schematic of meter-response and sensitivity-adjustment control system.

this also posed some difficulties. If the coupling were placed at the iris ring, an index mark and scale (or two scales) would be carried on a moving member and would require that the lens barrel become crowded with numbers and adjustments. Other positions involved at least the disadvantage of a moving index point until the adjustment was finally visualized as a mechanical rotation of the galvanometer body. At this point, things began to fall into place logically and rapidly. The only basic requirement involved was that the galvanometer deflection be proportional to the desired iris-ring deflection, and thus (because of the "linear" iris) proportional to the logarithm of photocell illumination. This enabled us to retain the meter in a rotatable barrel, place a scale on both the barrel and its adjacent fixed member, and thereby obtain a slide rule into which could be fed the two variables of emulsion speed and exposure time.

Control System Design

While a detailed description of the design procedure is beyond the scope of this paper, the more important factors in the design will be discussed briefly, so that some feeling for their effect on the system can be obtained.

Meter Response and Sensitivity Adjustment. Two methods of obtaining the necessary logarithmic meter response presented themselves. The first of these, which is widely used in exposure meters, was to make the meter deflection proportional to the logarithm of meter current. However, in discussions with potential suppliers we found that sacrifices in accuracy, meter torque, or compactness would have to be made. The second means involved placing an unusually high resistance in series with the photocell to cause its current-vs.-illumination characteristics to become logarithmic. This latter approach allowed the use of a high-torque, compact, and linear internal magnet meter, though at the same time it made the system temperature-sensitive. While this latter approach was a new one, it was adopted as soon as a means of overcoming temperature sensitivity was developed.

The system then evolved into the form shown schematically in Fig. 2. The two contacts which "trap" the meter needle are mounted on a gear which is concentric with the meter. If the meter body is mechanically rotated about its axis, the deflection of the meter needle is then composed of the electrical deflection of the meter plus this rotational adjustment.

The desired angular deflection of the iris ring and meter in response to the variables of subject brightness, emulsion speed and exposure time, can be derived in a formal manner as follows:

The system is based on the well-known "exposure meter equation":

$$f^2 = KB_0ST \qquad (1)$$

where

f is the lens-iris setting;
K is a constant;
B_0 is the average subject brightness in candles per square foot;
S is the ASA emulsion index of the film used; and
T is the exposure time in seconds.

Taking the logarithm of both sides,

$$\log f^2 = \log K + \log B_0 + \log S + \log T \qquad (2)$$

Since the lens iris is "linear," its angular deflection is proportional to $\log f^2$, and can be expressed as $C \log f^2$. The equation now becomes:

$$I = C \log f^2 = C(\log K + \log B_0 + \log S + \log T) \qquad (3)$$

The desired total meter deflection is the iris deflection multiplied by the gear ratio, G, between the contact gear and the iris ring:

$$M = CG \log f^{2\prime} = CG(\log K + \log B_0 + \log S + \log T) \qquad (4)$$

or,

$$M = CG \log f_2^2 = CG \log K + CG \log B_0 + CG \log S + CG \log T \qquad (5)$$

Each of these terms has a particular significance. "$CG \log K$" is the initial setting of the meter and "$CG \log B_0$" is the electrical deflection of the meter in response to the average subject brightness. "$CG \log S$" and "$CG \log T$" are mechanical meter deflections obtained by rotational adjustment of the meter body to properly bias the system for emulsion speed and exposure time, respectively. Since these are additive expressions, a convenient slide-rule scale can be used to feed these quantities into the system.

Acceptance Angle. Acceptance angle is the solid angle through which light is transmitted to the photocell. In this design, the photocell always points in the same direction as the camera lens, with the measurement automatically repeated as a setting of the lens iris. Ideally, the acceptance angle should thus conform precisely to the field of view of the lens, so that the photocell truly measures the average brightness of all of the photographed area and nothing more. If acceptance angle were the sole consideration, the 20mm-lens focal length selected would dictate a field width of 29°.

It will be realized, of course, that this is a different problem from that of an exposure meter, which permits judgment to be exercised both in the pointing of the meter and interpretation of the measurement. On the other hand, such a small acceptance angle results in very little light being transmitted to the photocell, limits its current output, and operates it at a low level where its current-illumination characteristics depart objectionally from the desired logarithmic response.

Photocell Size. The current output of a photovoltaic cell varies with size, with a larger cell supplying more current to the meter. This results in greater meter

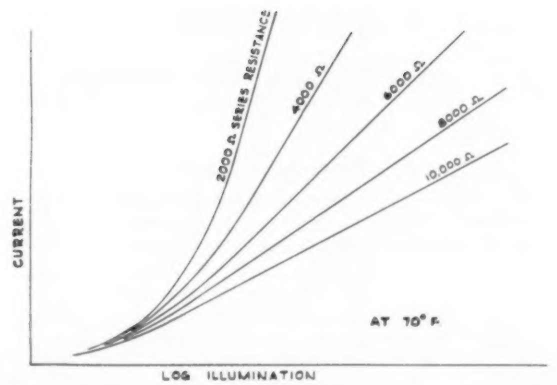

Fig. 3. Photocell characteristics: current vs. illumination at various resistances.

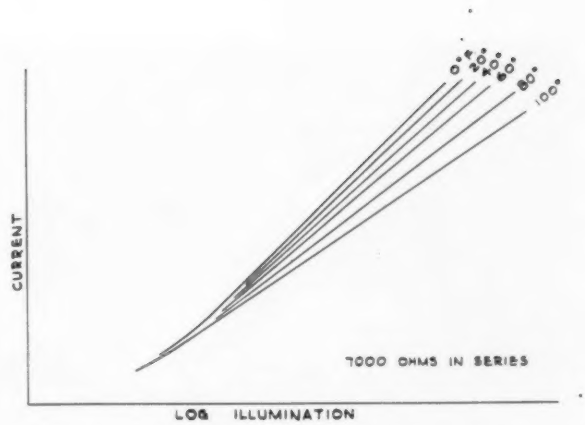

Fig. 4. Approximate photocell characteristics: current vs. illumination at various temperatures.

torque, system range and system accuracy. On the other hand, a cell whose area is considerably greater than that of the lens barrel would require increasing the frontal area of the camera and would detract from its appearance

Meter Sensitivity. In a given frame size, meter-current sensitivity and torque are inversely related. Greater sensitivity allows smaller acceptance angles, smaller photocells, or increased series photocell resistance. At the same time, meter torque is decreased resulting in less dependable switching and increasing the likelihood of meter damage in handling.

Photocell Loading. The range of illuminations in which logarithmic response is obtained increases with an increase in series resistance. At the same time, the current output is reduced and variation with temperature change increases. Figure 3 shows the effect of various series resistances on photocell output, and Fig. 4 shows the effect of temperature on output for one particular loading.

Accuracy. The computed accuracy increases as the photocell is more heavily loaded to obtain a true logarithmic response, or as the acceptance angle is increased to avoid the toe portion of the curves shown in Fig. 3. The toe portion is also avoided, of course, by restricting the use of the system to low emulsion speeds and short exposure times. Traveling too far in this direction, as mentioned before, causes greater temperature sensitivity and an unreasonable amount of compensation to overcome it, or less calculable but very real errors because of the poor match between photographed and measured fields.

Selected Design Constants

Consideration of these interrelationships led to the use of a $1\frac{1}{2}$-in. diameter photocell, an acceptance angle of 38°, and a nominal resistance loading of 8500 ohms. The 100° full-scale deflection of the meter is obtained at a current of 50 μa. The photocell load is composed of a 3000-ohm meter coil, with the remainder being a thermistor–resistor pair and a trimming resistor. The function of the thermistor–resistor pair is to provide a resistance-vs.-temperature characteristic which is equal and opposite to that of the photocell. When placed in series with the photocell, the effect of temperature on the sensitivity of the system becomes almost negligible. The trimming resistor provides for unavoidable variations in the current-vs.-resistance characteristics of individual photocells. This combination results in an inherent design error ranging from 0.0 for emulsion speeds from ASA 10-25, to 0.1 lens stop at ASA 32 and 0.5 lens stop at ASA 50. Individual cameras are adjusted to within $\pm\frac{1}{8}$ lens stop of this design accuracy.

Power Source

The main consideration in providing mechanical power to drive the lens iris was economy of bulk. The combination of mercury batteries with a modified model train motor accomplished this purpose, meanwhile supplying a safe margin of driving torque to the lens iris. The resulting "power package," which also includes two worm-and-gear sets and a friction coupling, required only an additional thickness of $\frac{7}{8}$ in. on the bottom of the camera.

Refinements and Features

At this point the system was workable, but it still required additional refinements to make it a consumer product. For one thing, there was nothing to prevent the motor from attempting to drive the lens iris past its widest or smallest openings, with consequent high and damaging battery-current drains. Then there was the problem, since this was to be a

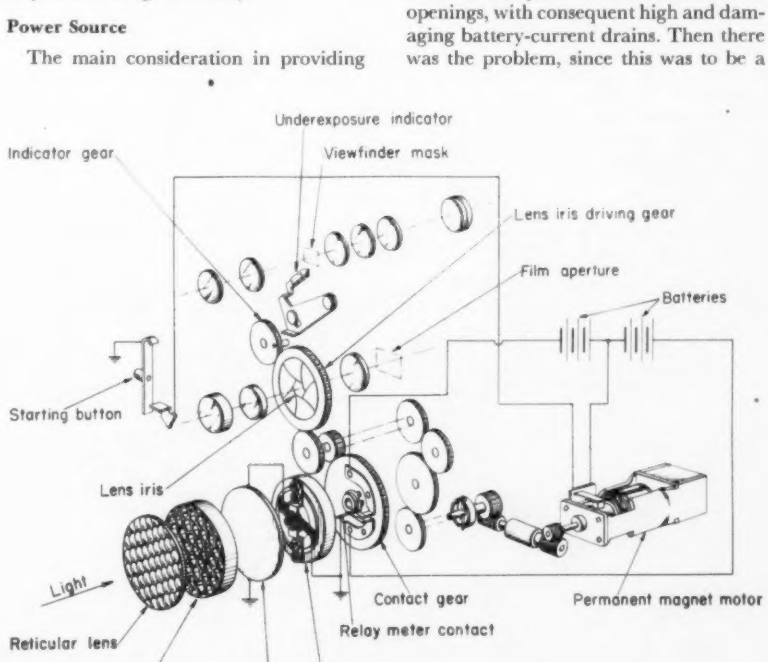

Fig. 5. Functional diagram of the new automatic iris control.

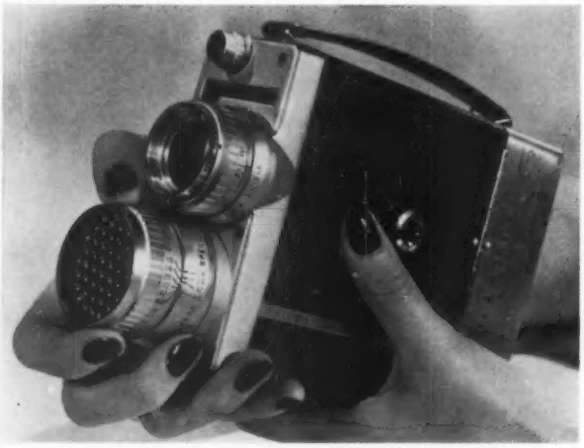

Fig. 6. The Bell & Howell Design 200-EE camera.

"foolproof" exposure control, of warning the operator whenever there was insufficient light available for photography. There were also further provisions to be made so that the iris could be operated manually without damage to the system and so that the control became operative whenever there was an attempt to run the camera.

Automatic power shutoff was obtained by placing mechanical stops to limit the travel of the meter contact. These stops are placed on the stationary frame of the camera, and are so adjusted that the meter contact cannot direct the system to drive the iris past its extreme positions.

The underexposure indicator evolved into a flag which appears in the viewfinder when the iris nears its maximum opening. This was accomplished by a pivoted arm whose free end can project into the viewfinder, and which is lifted into that position by a pin carried on a gear driven by the lens-iris gear.

Manual operation of the lens iris can be accomplished without damage because of a slipping clutch which is placed at the coupling between the "power package" and the camera front plate. A proper linking of the automatic control with camera operation was obtained by placing a single-pole switch underneath the camera starting button. The motor circuit is not completed until there is inward pressure on the button. The circuit is also completed whenever the button is pressed downward to operate the camera mechanism. Most of the functions which have been described are illustrated in Fig. 5.

The Complete Camera

Figure 6 shows the complete camera. The motor, batteries and two worm-and-gear sets are housed in the casting which has been added to the bottom of the camera. The photocell and meter are in the control barrel which is beneath the camera lens. The remainder of the automatic iris-control components such as the underexposure indicator and contact gear are placed in the camera front plate.

As an illustration of the operating simplicity which has been achieved with this camera, the following operations are all that are required to obtain acceptably exposed film:

(1) insert a film magazine;
(2) set the control barrel for the ASA film emulsion rating and camera speed to be used;
(3) wind the camera;
(4) focus the lens;
(5) press the button; and
(6) do not shoot when the underexposure indicator appears.

These operations can be even further simplified for the novice, since the control barrel can be locked in place by the dealer, and the depth of field of the lens is such that its universal focus setting is adequate for virtually all outdoor shots.

An All-Electronic Counter for Projection and Other Film Uses

By DON V. KLOEPFEL

This paper describes an all-electronic film footage, frame or scene counter, with features not usually found in projection-room counters. The method of obtaining a large visible read-out, instant zero-set and other features, without noise or heat-producing components, is noted. A brief description of electronic beam-switching tubes is included.

The counter was designed primarily to be used in motion-picture laboratories, studio review rooms, sound dubbing and scoring rooms and studio theater auditoriums. These are usually equipped with some counting device visible to the entire audience. Footage and scene counting is used in laboratories for locating printing and other defects and scene mis-lights. Footage counting is necessary in sound dubbing and scoring rooms to enable mixers to follow cues. The chief desirable features of a counter for these uses are:

(1) completely silent operation;
(2) ability to hold the count;
(3) ability to continue the count after hold;
(4) instant zero-set; and
(5) distinctive in-line read-out of adequate size and illumination.

Some important design considerations are:

(1) ease of servicing and low maintenance;
(2) long life of components;
(3) adequate speed range for frame, scene or footage counting; and
(4) simplicity of control.

This counter is designed to meet these requirements. Entirely electronic, it has no moving parts, and the life expectancy of the major component is 50,000 hr. The complete counter weighs 26 lb, is 22 in. wide, 32 in. deep and 8 in. high. It is self-contained except for the actuating device or devices, and the control station. It requires but a single cable for connection to the actuating devices and the power source.

The read-out is visible on a ground-glass screen, in neon red numerals about 3 in. high and designed for viewing at a distance of about 40 ft. Larger numerals are, of course, possible with a different choice of optics.

The cabinet is aluminum. If it is desired, additional read-outs may be paralleled with a slight change in design.

Presented on May 3, 1957, at the Society's Convention at Washington, D.C., by G. Carleton Hunt for the author, Don V. Kloepfel, General Film Laboratories Corp., 1546 N. Argyle Ave., Hollywood 28.
(This paper was received on March 28, 1957.)

The Beam-Switching Tube

As the heart of the device is the beam-switching tube, a brief description of it is included.

The Burroughs Magnetron Beam-Switching tube is a high-vacuum device consisting of ten identical positions mounted radially about a center oxide cathode (Fig. 1). Each individual position contains three electrodes, the spade, the target and the switching grid. These three electrodes are used to form an electron beam, lock it in position, clear the beam and provide a constant current output.

An axial magnetic field is provided by a small cylindrical magnet which is permanently attached to the glass envelope. When the potential of all the spades is positive, the tube is in a cutoff or clear position — no beam is formed. The beam may be formed on any one of the ten positions by sufficiently lowering the potential of the respective spade. Thus, the one spade forming and locking the beam is at near-cathode potential, while the remaining ones are at a high positive level.

When a beam is formed on a spade it can remain there indefinitely, or it can be advanced by lowering the switching-grid voltage. The direction of switching is clockwise due to the polarity of the magnetic field. When the switching-grid voltage is lowered sufficiently, a change takes place in the electric field between

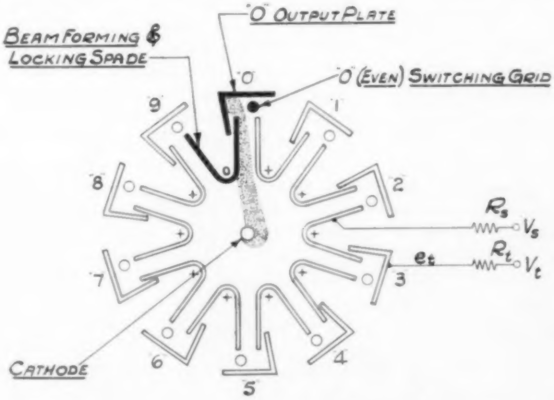

Fig. 1. Diagram of the Burroughs Magnetron Beam-Switching tube.

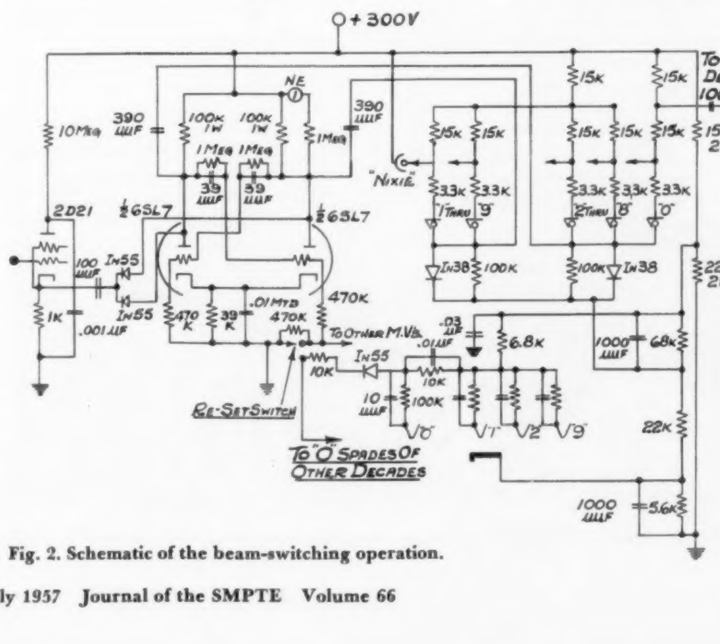

Fig. 2. Schematic of the beam-switching operation.

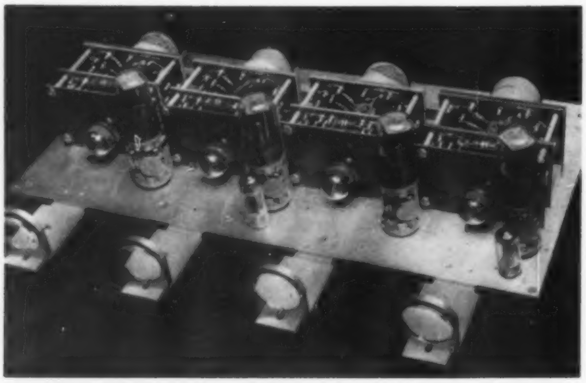

Fig. 3. Chassis assembly showing four decades, four multivibrators, the thyratron and the rectifier mounted.

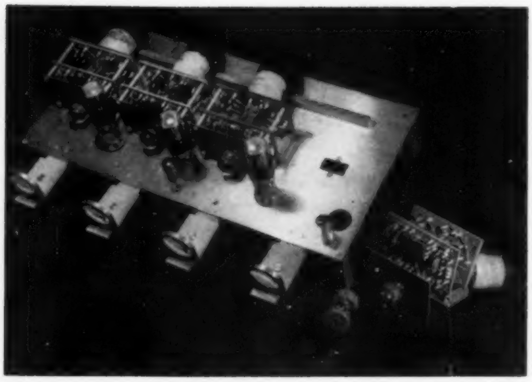

Fig. 4. Chassis assembly and a partially exploded view of a plug-in decade, showing its construction.

the spades, diverting enough of the beam to the leading spade to cause that spade to assume its locked-in stable state.

About 90% of the beam is available to an external load, with constant current characteristics. In this application, the output is fed directly to the corresponding digit of a Burroughs Type 6844 or "Nixie" indicator tube.

The Numerical Indicator

The Burroughs Type 6844 or "Nixie," is a gas-filled, cold-cathode 10-digit (0 to 9) numerical indicator, having a common anode for voltage prebiasing. In this counter, a beam-switching tube and an indicator tube, together with their associated circuits, are assembled in the form of a plug-in decade. Four such units are so coupled and arranged as to form an in-line read-out of 0000 to 9999. Simple plano-convex lenses focus the numerals on a ground-glass screen at about 3× magnification.

Operation

Although a variety of inputs may be used with these beam-switching tubes, impulses from a switch or relay cannot be used directly because of contact bounce. In this application, a voltage is developed by passing a permanent magnet over the pole piece of a coil, and this voltage used to fire a thyratron (Fig. 2). The output of the thyratron, a pulse with a steep wavefront, is then used to trigger a bistable multivibrator.

After power is applied and a slight warm-up period allowed, the zero-set switch is pressed, making the multivibrator conduct on the half connected to the odd grids and putting all zero spades of the beam-switching tubes at cathode potential, thus forming and locking the beams on zero. All even grids of the beam-switching tubes are tied together, as are all odd grids. Thus, each stable state of the multivibrator will advance the beam one step. The first pulse lowers the even grids on the first decade, causing the beam to switch to the "one" position. The next pulse lowers the odd grids causing the beam to switch to the "two" position, and so on. These pulses are negative going. The zero target of the first beam-switching tube is coupled to another bistable multivibrator which is the input for the next decade. In this manner, a transfer is effected and the result indicated in units, tens, hundreds and thousands. The count can be stopped and held at any time by interrupting the pulsing circuit. It can be started from that count, or instantly zero-set and started again. Provision is made to eliminate any spurious pulses, which in some instances might result in an additional count.

The chassis assembly is shown in Fig. 3, with the four decades, the four multivibrators, the thyratron and the rectifier tube mounted. The lenses are shown on adjustable brackets and the underside contains the rectifier components.

Figure 4 is the assembly and a partially exploded view of a plug-in decade, showing its construction. A plug-in multivibrator is also shown.

While the design suggests the feasibility of using printed circuit technique, it was decided in this instance to construct and mount the units as shown.

Each decade is complete except for power and input, as is each multivibrator. Either unit is interchangeable with its counterpart.

Construction materials are nonferrous to prevent any possibility of affecting the operating characteristics of the beam-switching tubes. The tubes themselves are mounted $4\frac{1}{2}$ in. apart to minimize any interaction between their magnetic fields. The chassis is a polished Dural plate $\frac{1}{8}$ in. thick, $18\frac{1}{2}$ in. wide, and 10 in. deep, and mounted on $\frac{1}{2}$-in. square legs 3 in. high.

On the plate are mounted the receptacles for the plug-in components, the rectifier tube and the thyratron. The components of a full-wave, well-filtered rectifier are mounted underneath the chassis. The lenses used to enlarge the numerals andproject them on the ground-glass screen are mounted on individual plates in front of the indicator tubes.

Control Panel

The control panel, mounted on the auditorium console, consists of a three-position switch indicating "left–off–right," for selection of the actuating pulse. It also contains a momentary contact switch used to zero-set the counter. Means of switching the actuating pulse to read-out footage, frames or scenes is arranged in the projection room. Provision can be made to record counts automatically by using the projection change-over circuit as a switching device.

Conclusion

It is the opinion of the author that this counter excells in comparison with other methods now used, because it embodies all the desirable features as set forth at the beginning of this paper. The author wishes to express his appreciation to Carl W. Ericson, Applications Engineer for Burroughs Corp., for technical data on beam-switching tubes; and to Samuel Meyers, General Film Laboratories Corp. electronics technician for assistance rendered not only in the construction of the device, but in its design as well.

A New High-Speed Spray Processor for 16/35mm Black-and-White, Negative or Positive Film

By EDWARD V. LEWIS

This paper covers the design of a compact high-speed processor which incorporates the use of a modular "building-block" construction. The application of this principle allows the integration of the functional components of a particular spray chamber into a readily serviced unit. In this paper a reliable method for providing a vaportight seal in a spray chamber is described; and the inclusion of a washdown system as a means of preventative maintenance is discussed.

The advantages of the spray-processing technique as applied to high-speed processing of photographic films have been recognized and appreciated for many years. A primary benefit in the application of this approach in the design of a high-speed processor is achieved through the appreciable reduction in size and operating-space requirements. The processor (Fig. 1) described here is designed to employ fully and efficiently this salient feature.

This machine has a capacity for processing positive films at rates up to 150 ft/min and negative films at rates up to 100 ft/min. Its overall dimensions are 124 in. in length, 32 in. in width and 84 in. in height, with a dry weight of less than 2000 lb.

Employing a modular, or "building-block," type of construction, this processor is divided into a series of individual vaportight compartments, each containing an independent spraying system complete with pump, filter, temperature control and replenisher control flowmeter. Since each element is similar in configuration and construction, spray chambers may be moved or added to suit any processing procedure.

The loading table and load accumulator are intended for darkroom installation, while the entire processing and drying section is designed for daylight operation.

Combination 16mm and 35mm drive sprockets are provided in the film-transport system which has the wide-range variable-speed adjustment of from 25 to 150 ft/min. Each processing step provides 1 min of treatment at an operating speed of 120 ft/min with a dry-to-dry cycle of slightly more than 5 min. Using the variable-speed drive, the processing steps can be varied from 48 sec to a full 5 min in each step.

Two loading spindles, each with a capacity of 3000 ft of film, are provided on the loading tables. Flanges for both 16mm and 35mm film cores are supplied with the machine. Each spindle is equipped with a load alarm arm which actuates a signal buzzer to warn of the approaching end of film. In the event that this alarm goes unheeded by the operator, a solenoid film lock is automatically actuated by a microswitch located in the normal film path. This lock is so designed that it can be operated manually as well as automatically at the discretion of the operator. No changes or adjustments are required for changing over from 16mm to 35mm, or from 35mm to 16mm.

The film feeds into a "pulley-block" type of accumulator which has a storage capacity of over 100 ft of film. This accumulator consists of two carriages which are guided on parallel bars and are connected with cables which allow them to travel toward each other when the film lock is actuated. A simple detent is provided in order to hold the carriages in threading position. A switch, which actuates an alarm bell and shuts off the machine drive, is operated when the carriages reach the limit of their normal travel. The accumulator is assembled on a panel in order that it can be conveniently mounted on a darkroom wall.

The pass-through light trap serves a dual function in that it provides a lighttight and vaportight entry into the developer chamber. This is accomplished by running the film through a brief submerged developer wetting bath contained entirely within the light-trap structure. This solution is circulated through the same system which operates in the developer spray chamber. Preliminary tests have shown that the use of this brief immersion in developer solution minimizes the possibility of uneven wetting of the emulsion. The light trap is equipped with an easily removed lighttight lid which is sealed vaportight by the simple expedient of submerging the lid lip below the solution level.

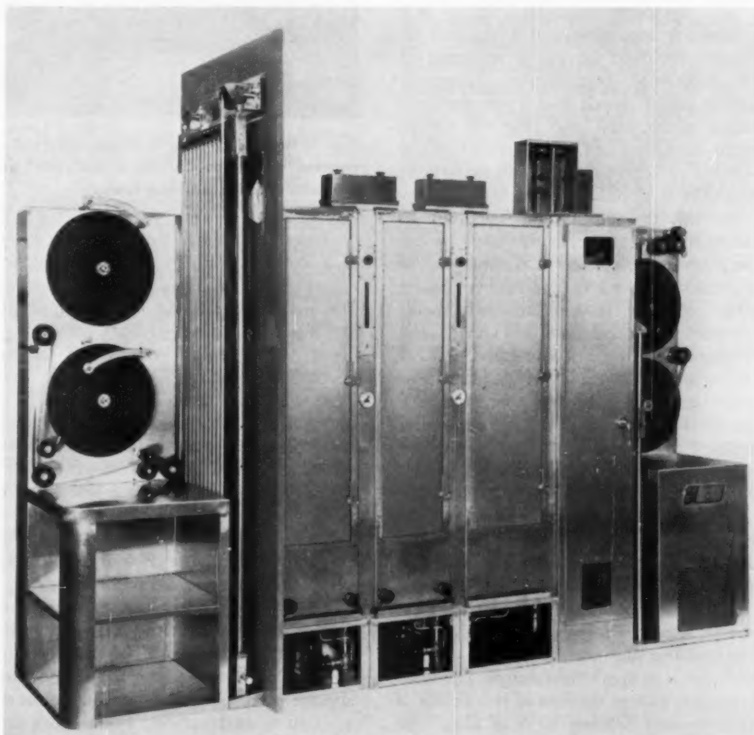

Fig. 1. The new high-speed spray processor: darkroom loading section at left; daylight processing and drying cabinets at right.

Presented on May 1, 1957, at the Society's Convention at Washington, D.C., by Arthur J. Kjontvedt for the author, Edward V. Lewis, Houston Fearless, Div. Color Corporation of America, 11801 W. Olympic Blvd., Los Angeles 64.
(This paper was received on April 1, 1957.)

Fig. 2. Typical spray chamber showing large access door, spray manifolds, replenisher flowmeter and spray pressure gauge.

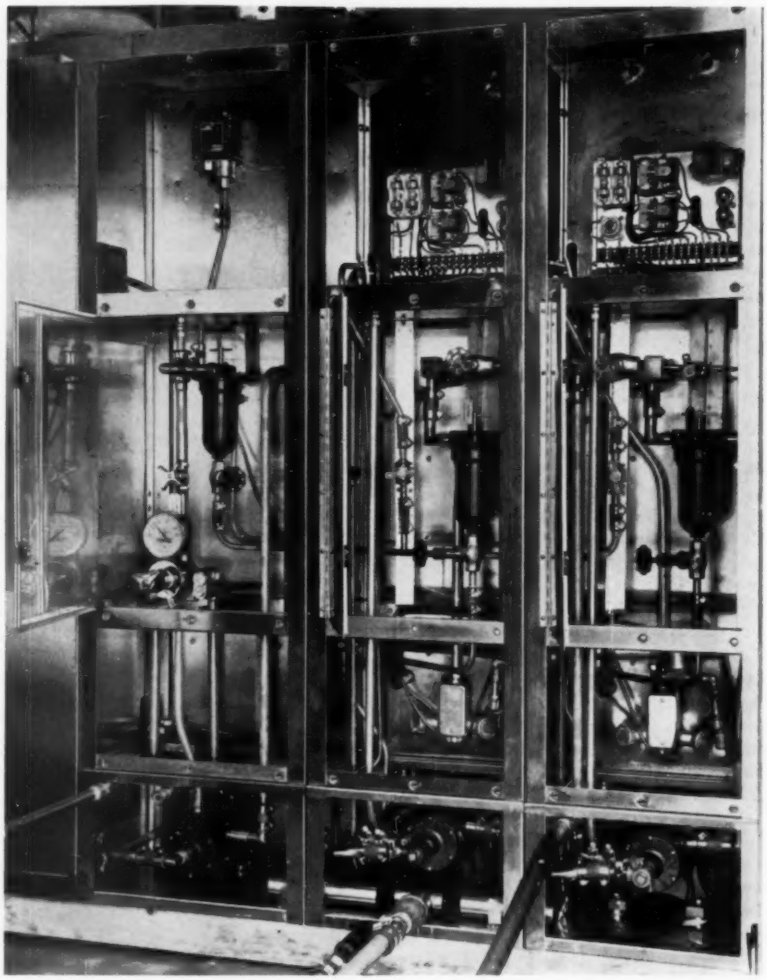

Fig. 3. Rear view of processor, showing electrical connections at top, plumbing and control valves in middle section and pumps at bottom. Color coding is employed on all valves and plumbing lines.

The developer chamber (Fig. 2) is a completely separable unit which can be readily removed for major servicing of its functional components. However, ample access panels and doors are provided in the front and rear for convenient threading and normal maintenance operations. This lighttight and vaportight chamber is identical to and interchangeable with the fix cabinet. The hinged, threading-access door is equipped with a peripheral-line contact seal consisting of an easily replaced sponge-rubber sealing strip mounted in a continuous metal channel. The door panel has an inverted V-shaped stiffener completely around its perimeter which is forced into a positive seal against the sponge-rubber gasket by means of three cam-action locks. The cabinet is mounted on a frame which contains the developer plumbing, filter and pumping system. All electrical connections are made at terminal blocks located in the upper rear of the frame. All plumbing connections are made at the base of the cabinet frame (Fig. 3).

Each cabinet contains its own solution sump. A pair of solution heaters, a chilling coil and thermostats are provided for individual temperature control. The film-transport system consists of two banks of rollers, each holding 60 ft of film. The upper shaft assemblies consist of eight rollers, seven of which are "cycolac" idlers mounted on Pyrex-glass ball bearings. The eighth roller on each shaft is a combination 16/35mm film-drive sprocket. Any of these top shafts can be disconnected from the drive line shaft and easily removed without tools. The lower roller shafts consist of seven "cycolac" spools, also mounted on Pyrex-glass ball bearings, supported in a spring-loaded carriage which provides a uniform film tension. These carriages are equipped with stainless-steel, ball-bearing rollers which ride in parallel guide tracks. Any carriage asembly can be removed for inspection or for cleaning by simply removing two thumbscrews which hold the guide tracks in place.

The spray nozzles are mounted on header tubes spaced to give approximately 1-sec intervals between spray banks. Full-flooding, flat fan-spray nozzles are used to apply an even amount of solution to each strand. The nozzles are positioned so that the jet stream is impinged at an angle of 45° to the film travel. All manifolds and spray headers are arranged so that they are self-draining. Clean-out plugs are provided on all headers and manifold risers.

A flushdown system is so arranged that integral sections or the entire system can be purged of chemicals in a very short time. This is an important advantage not only for proper maintenance in keeping the spray jets clean, but also because it is highly useful when changeover to another developer solution is desired.

At the end of an operating period, the sump can be drained, since it contains only 5 gal of solution, and a valve which admits wash water to the spray system is opened. Experience has shown that a period of approximately 10 min flushing time with water at 5 gal/min and 10 lb pressure is adequate for thoroughly purging the entire circulatory system including the pump, filter, manifolds and spray tips. This not only cleans the spray tips and manifolds, but will thoroughly rinse the rollers and cabinet interior and will

prevent the formation of crystalline deposits.

The chemical circulating system includes a pressure gauge, mounted on the front face of the machine, which immediately indicates any irregularities in the spray system, such as a clogged jet or filter. The filter used is the "Cuno" edge type which is cleaned by periodically turning the rotor T-handle. The sump of this filter is connected to the drain manifold through a valve.

A replenisher flowmeter is mounted immediately adjacent to the developer spray chamber. It is calibrated to indicate in gallons per hour, the amount of replenisher which is being introduced into the system. The exhausted solution in the sump is ejected through an overflow tube.

On the exit end of the developer cabinet a second vaportight seal is provided by means of the spray-rinse crossover tank. This unit combines the function of a fresh-water rinse and a vaportight seal for the cabinets on either side. An easily removed lighttight cover provides the vaportight seal by virtue of the fact that its lip is submerged below the rinse-water level. This type of water seal lends itself very conveniently as an equalizing means if pressurization is employed in the spray chambers, since it will allow gas to bubble out when a positive pressure (approximately $\frac{1}{8}$ in. of water) is applied to the chamber. We have found that the cabinet which holds approximately 7.5 cu ft of air, is hermetically sealed when the doors are closed and the cross-over rinse tanks are covered. The film passes through a submerged liquid seal at both ends of the cabinet and thus precludes the possibility of air entering with the film perforations.

We have conducted our tests with the developer and fix solutions both held at 90 F. With the temperature-control system it is possible to bring the solutions up to operating temperature within 10 min.

Solution carryover is minimized by use of a spray rinse and a pair of Teflon-covered squeegee rollers in the crossover tank assembly.

The fix-spray chamber is identical in construction and operation to the developer-spray chamber. This spray chamber is vapor sealed at its exit with a crossover tank which is identical to the other crossover tank.

In the wash cabinet there are two separate wash chambers. The wash is divided into two equal parts in order to effect a reduction in wash-water requirements. In this machine, the final wash consists of fresh hot and cold water, blended to an appropriate operating temperature by means of a "Powers" regulator valve. This water is then collected in a sump at the base of this chamber and is directed into the initial wash chamber by means of a wash-water pump. After the water has gone through both of these wash systems, it is ejected from the cabinet.

A pair of air squeegees is mounted in a splashproof cabinet located at the exit end of the wash chamber. In order to allow viewing of the film, this cabinet is provided with a sliding Lucite door.

The film is dried in an impingement-type dryer which contains two film banks. The center plenum chambers are easily removable for threading access. A total of six cloth-covered polishing drums is provided in order to help prevent the formation of water spots on the base side of the film. Since the dryer will operate satisfactorily at 90 F, which is the same temperature as in the processing chambers, the film is not submitted to thermal shock and is unlikely to be distorted or curled in drying.

The dryer, like the spray chamber, is an integrally separable unit and may be easily detached from the main processor assembly. The blower, heaters and air filter are located in a compartment on the back of the drying cabinet. The air inlet is so arranged that heat from the refrigeration and drive units is drawn off and is used for preheating the drybox air. The drybox air exhaust is so located that the hot, humid air can be easily ducted out of the processing room.

A silicone applicator or a waxer can be mounted on the exit end of the drybox in such a manner that an optional threading path can be used when the applicator is omitted. An exit accumulator provides a safety factor for take-off spindle change over time.

The take-off table is equipped with two torque-motor-driven take-up spindles, each capable of accommodating 3000 ft of 16mm or 35mm film. The film take-up tension can be adjusted by means of an adjustable autotransformer. A three-position "On-Off-On" selector switch controls the operation of these take-up motors. A clutch-driven "come-along" drive roller is mounted at the upper righthand corner of the take-off table. This roller is overdriven in order to be capable of lifting the exit accumulator. An eccentric type of film lock stops this roller when required for changing take-up flanges.

The take-off table serves as a housing for the variable-speed drive unit and for the refrigeration compressor. Large, easily removed access panels are provided for convenient servicing and inspection.

The electrical control panel is located on the end of the take-off table. Switches are provided for individual control of the functional components, but these are all channeled through an interlocking switch which prevents the operation of the film-transport mechanism until all of the appropriate elements are turned to the "On" position. The drybox thermometer and thermostat, as well as the solution thermometers, are located on this panel. The variable-speed control and indicator are also mounted here. A pushbutton station which controls the stopping and starting of the drive is provided at both ends of the machine.

The functions of all valves are indicated by stamped metal tags which are permanently attached to them. Color coding is used for identification of all valves, pumps, lines, inlets and outlets in this processor in order to minimize the possibility of operator error.

A great deal of attention was given to the modular, or "building-block", system in the construction of this machine. Every component was so arranged that it could be detached easily from the adjacent structure. For example, the main driveshaft is segmented into increments, each as long as the particular cabinet element, and is provided with a flexible coupling at both ends. The refrigeration lines are provided with union couplings at each cabinet joint. All electrical lines are numerically identified and are connected at terminal strips. Sleeve couplings are used at all plumbing connections to facilitate the removal of each component (Fig. 3).

The "building-block" principle of construction lends great versatility to this processor. Chambers can be added to accommodate other processing procedures or increase the output capacity. This can be accomplished with a minimum of "down-time" and expense.

Motion-Picture and Television Instruction in U.S. Colleges and Universities, 1956–1957—Part I, Motion-Picture Instruction

By DESMOND P. WEDBERG

In 1945 the SMPE Committee on Motion Picture Instruction was established to collect information for the Society on motion-picture course offerings in the nation's colleges, universities and institutes. Chairman John G. Frayne reported the findings of the first study in the Journal in 1946.[1] A follow-up study by Jack Morrison, President of the American Educational Theater Association, was published in the Journal in 1950.[2] The report that follows, in two parts, while patterned after the Frayne and Morrison surveys, has been broadened in scope to include TV courses offered in U.S. institutions of higher education. The motion-picture and television instruction reports will be published in separate parts, because the two fields, though related, tend to remain separate entities in today's curricula.

Data on motion-picture courses were gathered primarily from annual and biannual college bulletins and course announcements for the school years 1955–57. Information on institutions where clusters of motion-picture courses are known to exist was obtained from the Curriculum Committee of the University Film Producers Association, an unpublished doctoral dissertation by Ellis,[3] a published report by Whitehill of the Committee on Motion Pictures of the Speech Association of America,[4] a survey published by UNESCO,[5] and a survey published by TerLouw of Eastman Kodak.[6]

Such *a potpourri* of motion-picture course titles was discovered in research that it became necessary to group courses in general categories for purposes of statistical tabulation. The five basic types of motion-picture courses, with subcategories and explanations, are listed below as a guide to interpreting Tables I and II.

Type I — General Understanding of Motion-Picture Media

A. Introductory survey
B. History, criticism, appreciation (film as an art form)
C. Nontheatrical films (documentary, educational, industrial, etc.)
D. Utilization
E. Research

Type II — The Motion Picture as a Mass-Communication Medium

Type III — Production (Courses Covering Several Phases of Production)

A. Acting (including narration)
B. Animation
C. Cinematography (motion-picture photography)
D. Decor (sets, props, costumes, make-up)
E. Directing
F. Editing
G. Laboratory techniques (including special effects)
H. Lighting
I. Motion-picture production in audio-visual education, industry, government
J. Motion-picture production in television
K. Music
L. Sound recording
M. Supervision and management
N. Writing

Type IV — The Motion-Picture Business (Distribution, Exhibition, Economics, Public Relations and Advertising)

Type V — Projection and Equipment Maintenance

While previous surveys have included related courses in tabulations, such courses were omitted from this report when the subject matter (as outlined in the printed course description) did not appear to give primary attention to the motion-picture medium. Thus, courses in still-camera photography, optical physics, evaluation of audio-visual materials, pictorial journalism, etc., were not included; yet, courses in production of audio-visual materials (including motion-picture production) and general communications (including a study of the motion picture as one of the mass media) were listed.

Findings

Eight universities offer a complement of courses leading to the Bachelor's and/or Master's degree with a major in motion pictures (Table I). Of the motion-picture courses offered by these institutions, 70% involve the student in one or more phases of film production.

According to the data secured, 55 institutions of higher learning in 25 states offered 275 courses largely motion-picture in nature. Of these 275 courses, 24% were Type I (General Understanding); 9.8% were Type II (Mass-Communication); 64% were Type III (Production); 1.5% were Type IV (Business); and 0.7% were Type V (Projection and Equipment Maintenance). No course in Motion-Picture Music, alone among the courses involving various phases of film production, was offered by the institutions from which data were secured between 1955 and 1957. Of the 176 production courses offered, 23% included several phases of film production in one course, 14% were motion-picture photography

Table I. Universities Offering Degrees With Motion-Picture Major.

Institution	Department	Degrees*	Courses giving degree credit: I	II	III	IV	V	Total
University of Southern California, Los Angeles	Cinema	B.A., M.A.	9	2	32	2	1	46
University of California at L.A.	Theater Arts	B.A., B.S., M.A.	8	1	23			32
Bob Jones University, Greenville, S.C.	Cinema	B.S., M.S.	2		24		1	27
Boston University, Boston	Audio-Visual Communication	B.S., M.S.	5	7	6			18
New York University, New York	Motion Pictures	B.A., B.S.	1	1	12	1		15
Columbia University, New York	Dramatic Arts	B.F.A.†	3	1	8			12
University of Miami, Coral Gables, Fla.	Radio, TV and Film	B.A., B.S.	1	2	7			10
City College of New York, New York	Films	B.A.	2		6			8

* Univ. of Iowa offers the B.A. and M.A. in Speech with a TV-Radio-Film major. Univ. of No. Carolina offers a graduate degree in Communication with a Radio-TV-Motion-Picture major.
† Columbia University offers a M.F.A. in Dramatic Arts with a Motion-Picture minor.

A report received on April 10, 1957, from Desmond P. Wedberg, Chairman, Subcommittee on University and Technical School Curricula, SMPTE Education Committee, c/o *Film and AV World*, 6327 Santa Monica Blvd., Los Angeles 38.

courses, and 11% were courses in film writing.

The 275 motion-picture courses were offered by 66 departments. Of these 66 departments, 20 were in the film-photography-TV-radio category; 26 were in the theater arts, speech, English category; and 20 departments were classified as communication, education, and miscellaneous. (See Table II for complete course listings.)

Conclusions and Recommendations

With the limitations placed upon related motion-picture courses and the addition of film-communication courses, it is difficult to compare the present survey with those published in the *Journal* in 1946 and 1950; however, a comparison in motion-picture production course offerings can be made (Table III).

Table III. Comparison of Motion-Picture Production Courses Offered in 1946, 1949 and 1956.

Course Emphasis	1946*	1949†	1956
Several phases of production	1	12	40
Acting	—	2	4
Animation	—	5	6
Cinematography (motion-picture photography)	8	15	25
Decor (set design, props, costume design, make-up)	—	11	12
Directing	—	10	11
Editing	3	9	12
Laboratory techniques (including special effects)	—	2	5
Lighting	—	2	3
Motion-picture production in audio-visual education, industry, government	1	7	12
Motion-picture production in television	—	1	14
Music	—	—	—
Sound recording	3	4	6
Supervision and management	—	2	6
Writing	—	18	20
Totals:	16	100	176

* Reported in Frayne study.
† Reported in Morrison study.

Table II. Motion-Picture Courses Offered in U.S. Colleges and Universities, 1956–57.

Institution	Department	Course Title	Type	Credits	Grad.*
Alabama					
University of Alabama, University	Radio and TV	Introduction to Cinema	I-A	2	
		Radio, TV and Cinema Acting	III-A	2	
		TV Film Production	III-J	2	
		Theories of Communication	II	3	X
Arizona					
Arizona State College, Tempe	Education	Production of Audio-Visual Aids	III-I	2	
California					
California College of Arts and Crafts, Oakland	—	Experimental Motion Pictures	III	3	
California School of Fine Arts, San Francisco	—	Film Workshop	III	4	
		Advanced Film Workshop	III	4	
		Film Seminar	I-B	1	
Long Beach City College, Long Beach	Photography	Advanced Photography	III-C	1	
Los Angeles City College, Los Angeles	Drama	Social Aspects of Mass Communication	II	3	
Mills College, Oakland	Speech and Drama	Introduction to Theater	I-B	3-3	
San Francisco City College, San Francisco	Photography	Fundamentals of Motion-Picture Photography	III-C		
		Motion-Picture Workshop	III	1-1	
		Location Shooting	III	2	
San Francisco State College, San Francisco	Art, Drama and English	The Film Medium	I-B	3	
		Theater Enjoyment	II	2	
		Film Appreciation	I-B	3	
San Jose State College, San Jose	Speech and Drama	Motion-Picture Appreciation	I-B	2	
University of Southern California, Los Angeles	Cinema	Introduction and Survey of Motion Pictures	I-A	3-3	
		Elements of Production	III	3	
		Filmwriting	III-N	3	
		Color-Separation Negatives	III-G	3	
		Color Printing	III-G	3	
		Camera	III-C	3	
		Editing	III-F	3	
		Sound	III-L	3	
		The Documentary Film	I-C	2	
		Cinema and Society	II	2	
		Filmic Expression	I-B	2-2	
		Advanced Filmwriting	III-N	2-2	
		Theatrical Filmwriting	III-N	2-2	
		Lighting I	III-H	3	
		Lighting II	III-H	3	
		Advanced Camera	III-C	2-2	
		Editing the Sound Film	III-F	3	
		Advanced Editing	III-F	2-2	
		Advanced Sound	III-L	2-2	
		Cinematic Effects	III-G	2	
		Motion-Picture Processing	III-G	3-3	
		Animation	III-B	3	
		Art Direction	III-D	3	
		Film Distribution	IV	2	
		Public Relations in Motion Pictures	IV	2	

* Course gives undergraduate and/or graduate credit.

Table II, Cont'd.

Institution	Department	Course Title	Type	Credits	Grad.*
University of Southern California, Cont'd.		Theatrical Film Symposium	I-B	3	
		Cinema Directing	III-E	2	
		Senior Production Workshop	III	2-2	
		Cinema Workshop	III	2-2	
		Cinema History and Criticism	I-B	3	X
		Creative Cinema	I-B	2-2	X
		Seminar in Screenwriting	III-N	2-2	X
		Seminar in Camera	III-C	2	X
		Seminar in Film Editing	III-F	2	X
		Seminar in Motion-Picture Engineering	V	2	X
		Production Design	III-D	2	X
		Films for Television	III-J	3	X
		Production Supervision	III-M	2	X
		Documentary Direction	III-E	2	X
		Documentary Production	III	4-4	X
		Directed Research	I-E	2-2	X
		Film Research and Testing	I-E	2	X
		Seminar in Motion-Picture Direction	III-E	2-2	X
		Workshop in Educational Film Production	III-I	2-2	X
		Special Problems	I-E	2 to 8	X
	Communication	Survey of Mass Communication	II	3	
	Law	Legal Problems in the Entertainment Industry	IV	2	X
Stanford University, Palo Alto	Speech and Drama	Development of the Motion Picture	I-A	4*	
		Film for Television (Summer)	III-J	3*	
University of California at L.A.	Theater Arts	Social Aspects of Mass Communication	II	2	
		History of the Theater Arts	I-B	3	
		Film Techniques	III	2	
		Theater Arts Crafts—A	III-D	2	
		Theater Arts Crafts—E	III-M	2	
		Theater and Motion-Picture Costume Construction	III-D	2	
		Training in the Technical Operation of Motion-Picture Production	III	1	
		Theater Arts Administration	III-M	2	
		Acting for the Motion Picture	III-A	2	
		Theater Make-up	III-D	2	
		Motion-Picture Direction	III-E	2-2-2	
		Motion-Picture Editing	III-F	2-2	
		Writing for the Screen	III-N	3-3	
		Production Designing for the Theater Arts	III-D	3-3	
		History of Motion Pictures	I-B	2	
		Motion-Picture Animation	III-B	3	
		Advanced Motion-Picture Animation	III-B	3	
		Motion-Picture Animation Workshop	III-B	3	
		Elementary Motion-Picture Workshop	III	3	
		Intermediate Motion-Picture Workshop	III	3	
		Summer Motion-Picture Workshop	III	2-2	
		Educational and Documentary Film Techniques	I-C	2	
		Motion-Picture Photography	III-C	2-2	
		Color Cinematography	III-C	2-2	
		Special Studies in Theater Arts	I-E	1-4; 1-4	
		Advanced Motion-Picture Editing	III-F	2	X
		Film Aesthetics	I-B	2	X
		Seminar in the Documentary and Educational Film	I-C	3	X
		Seminar in the Fiction Film	I-B	3	X
		Research Projects in Motion Pictures	I-E	1	X
		Production Planning in Motion Pictures	III-M	1	X
		Special Problems in Theater Arts	III	2-5; 2-5	X
Colorado					
University of Denver, Denver	Theater	Introduction to Mass Communication Media	II	5*	X
		Film Arts	I-B	5*	X
		Motion-Picture Production	III	5*	X
		Film Techniques	III-C, H	5*	X
Delaware					
University of Delaware, Newark	Dramatic Arts and Speech	Theater, Film and Radio	I-A	3	
Florida					
Florida State University, Tallahassee	Library Service	Sound Film	I-A, D	3	
		Cinematography	III-C	3	
	Speech	Theater, Radio and Cinema Techniques in Television	III-J	3	
University of Miami, Coral Gables	Radio, TV and Film	Survey of Broadcasting and Film	I-A	3	
		The Radio, TV and Film Program	II	2	
		Introduction to Film	III	3	
		Film Laboratory Techniques	III-G	3	
		Script Laboratory	III-N	2-2	
		The Control of Radio, TV and Films	II	2	
		Motion-Picture Production Workshop	III	3	
		Summer Film Workshop	III	3-3	

* Course gives undergraduate and/or graduate credit.

Table II, Cont'd.

Institution	Department	Course Title	Type	Credits	Grad.*
University of Miami, Cont'd.		Laboratory Projects	III	2-2-2	
		Motion-Picture Production Direction	III-M	3	
Illinois					
Illinois Institute of Technology, Chicago	Design and Photography	Film History	I-B	2-2	
		Photography	III-C	13-13	
University of Illinois, Urbana	Journalism and Communications	Cinematography for Television	III-J	3	
		Economics of Communications	II	3	
Northwestern University, Evanston	Radio and TV	Introduction to Film	I-A	4*	
		Film for Television	III-J	4*	
		Mass Media and Society	II	4*	
		The History of Film	I-B	4*	
		Modes of Film Communication	II	4*	
		Television and Film Criticism	I-B	4*	
Southern Illinois University, Carbondale	Audio-Visual Education	The Medium of the Motion Picture	I-A		X
		School Film and Filmstrip Production	III-I		X
		Visual Learning	II		X
	Speech	Contemporary Developments in the Theater	I-A	4	
	Journalism	Communication Agencies and Public Opinion	II	3	
Indiana					
Indiana University, Bloomington	Radio and TV	Utilization of Television Films	I-D	3	
	Audio-Visual Materials	Survey of Audio-Visual Communications	I-C	2	X
		Production Techniques	III-I	3	X
	Radio and TV Education	Production	III-I	5-5	X
		Advanced Production	III-I	5-5	X
Purdue University, Lafayette	English	The Art of Motion Pictures	I-B	3	
Iowa					
Iowa State College, Ames	Technical Journalism	Motion-Picture Techniques	III-J	3	
State University of Iowa, Iowa City	Dramatic Art	Modern Theater	I-A	3 or 4	
	TV-Radio-Film	Cinematography Techniques	III-C	3	X
		Cinema Production	III-C	3	X
		Problems in TV, Film and Radio	III	Arr.	X
		Research in TV, Film and Radio	I-A	Arr.	X
Kentucky					
University of Kentucky, Lexington	Radio Arts	Cinematography	III-C	2	
Massachusetts					
Boston University, Boston	Communication Arts	Introduction to Communication	II	2	
		History and Survey of Communication	II	3	
	Radio and TV	Social Aspects of Mass Communication	II	3	
		Dramatic Writing	III-N	3	
	Audio-Visual Communication	Motion-Picture Production	III	4-4	
		Advanced Motion-Picture Directing	III-E	3	
		The American Film	I-B	3	
		The European Film	I-B	3	
		The Sponsored Film	I-C	3	
		Films in Television	III-J	3	
		Industrial Audio-Visual Communication	I-C	3	
		Oral-Physical Communication	III-A	3	
		Introduction to Graduate Study in Communication	II	3	X
		Psychology of Communication	II	3	X
		Social Goals of Communication	II	3	X
		The Teaching of Communication	II	3	X
		Graduate Motion-Picture Workshop	III	6-6	X
		Seminar in Problems in Communication	I-E	3	X
Michigan					
Michigan State University, East Lansing	Education	Local Production of Audio-Visual Materials	III-I	3	
Wayne University, Detroit	Speech	Writing for Stage, Screen and Radio	III-N	3	X
		History and Appreciation of the Motion Picture	I-B	2-2	X
		Fundamentals of Film Production	III	2	X
Minnesota					
University of Minnesota, Minneapolis	General Arts	Film and Drama	I-A	3	
	Speech and Theater Arts	The Art of the Theater	I-B	4	
New Jersey					
Seton Hall University, South Orange	Communication Arts	Film Techniques in Television	III-J	2	
New York					
Columbia University, New York	Dramatic Arts	Basic Course in Motion Pictures	I-A	3	X
		Screen Writing and Theories of Production	III-N	3-3	X
		Film Production	III	3	X
		Advanced Film Production	III	3-3	X
		Advanced Film Production: Special Unit	III-I	3-3	X
		History and Art of the Motion Picture	I-B	3	X

* Course gives undergraduate and/or graduate credit.

Table II, Cont'd.

Institution	Department	Course Title	Type	Credits	Grad.*
Columbia University, Cont'd.		History and Art of the Documentary Film	I-C	3	X
		Animation Workshop	III-B	3-3	X
		Recording for Films, Television, Radio and Phonograph Records	III-L	2	X
		Film Editing	III-F	3	X
		Cinematography	III-C	3	X
		Television, Radio and Films as Information Media	II	3	X
Cornell University, Ithaca	Speech and Drama	The Motion Picture: A Survey	I-A	3	
Fordham University, New York	Communication Arts	Communication and Society	II	2	
		Communication Arts Symposium	II	1	
New School of Social Research, New York	Communication	Script-Writing Clinic	III-N	2-2	
	Cinema 16 Film Center	The Film and Its Related Arts	I-B	2	
City College of New York, New York	Films	History of the Fictional Film	I-B	2	
		The Documentary Film	I-C	2	
		Fundamentals of the Documentary Film	III	2	
		Motion-Picture Photography	III-C	3	
		Motion-Picture Writing	III-N	3	
		Motion-Picture Editing	III-F	3	
		Practice in Film Production	III	3	
		Advanced Workshop	III	4-4	
New York University, New York	Communication Arts	Communication Arts in the Modern World	II	2-2	
		Acting Before Cameras	III-A	3-3	
	Motion Pictures	The Art of the Moving Image	I-B	2-2	
		Elementary Production	III	3	
		Elementary Direction	III-E	3	
		Screen Literature	III-N	2	
		Writing for the Moving Image	III-N	2	
		Screen and Video Writing	III-N	3-3	
		Motion-Picture Production	III	3	
		Workshop: Direction	III-E	3	
		Advanced Production	III	2-2	
		Advanced Screen and Video Writing	III-N	2-2	
		Motion-Picture Industry	IV	2	
		Editing: Film	III-F	2	
		Television Production	III-J	3-3	
Syracuse University, Syracuse	Audio-Visual Education	Cinematography: Fundamentals	I-A	3	X
		Cinematography: Production Techniques	III-C	3	X
North Carolina					
University of North Carolina, Chapel Hill	Dramatic Art	Writing for Radio, Television and Motion Pictures	III-N	3-3	
		Motion-Picture Production Arts	III	4	
Ohio					
Ohio State University, Columbus	Photography	Motion-Picture Photography	III-C	3*	X
University of Toledo, Toledo	English	Appreciation of the Motion Picture	I-B	2	
Western Reserve University, Cleveland	Dramatic Arts	Motion-Picture Production	III	3-3	X
		Practices in Script Writing	III-N	3-3	X
Oklahoma					
Oklahoma A&M College, Stillwater	Photography	Cinematography	III-C	2	
Oregon					
University of Oregon, Eugene	Speech	Appreciation of Drama	I-B	2-2-2	
Pennsylvania					
Allegheny College, Meadville	Speech and Dramatic Art	Development of the Film	I-B	2	
Pennsylvania State University, University Park	Theater Arts	Introduction to Motion-Picture Techniques	I-A	3	
		History and Appreciation of Motion Pictures	I-B	3	
	Education	Production of Visual and Auditory Media	III-I	3-3	
		Problems in Visual and Other Sensory Aids in Education	III-I	3	
University of Pittsburgh, Pittsburgh	Speech	The Motion Picture	I-A	3-3	
		Types of the Motion Picture	I-C	3	
South Carolina					
Bob Jones University, Greenville	Cinema	Fundamentals of Motion Pictures	I-A	3	
		Principles of Motion-Picture Sound	III-L	3	
		Camera I, II	III-C	3-3	
		Camera III, IV	III-C	3-3	
		Advanced Sound Recording	III-L	3	
		Film Editing I, II	III-F	3-3	
		Make-up for Motion Pictures	III-D	2	
		Scenic Design	III-D	2	

* Course gives undergraduate and/or graduate credit.

Table II, Cont'd.

Institution	Department	Course Title	Type	Credits	Grad.*
Bob Jones University, Cont'd.		Motion-Picture Projection	V	1	
		Cinema Directing	III-E	3	
		Advanced Editing III, IV	III-F	2-2	
		Cinema Seminar	III	3	
		Screen Writing	III-N	2	
		Motion Picture and Filmstrip Production Techniques	III-I	2	
		Cinema Workshop I, II	III	3-3	
		Professional Directing	III-E	3	X
		Graduate Editing	III-F	3	X
		Graduate Camera	III-C	2	X
		Seminar in Creative Cinema	III	3-3	X
		Advanced Screen Writing	III-N	2	X
		Advanced Scenic Design for Motion Pictures	III-D	3	X
		Directed Research	I-E	3	X
		Production Supervision	III-M	3	X
		Professional Sound Recording	III-L	3	X
		Color Photography	III-C	2	X
		Animation and Titling	III-B	2	X
		Cinema Workshop III, IV	III	3-3	X
Texas					
Amarillo College, Amarillo	Photography	Motion-Picture Photography	III-C		
Baylor University, Waco	Drama	Introduction to Drama, Film, TV	I-A	5*	
		Television and Film Workshop	III	6*	
		Stage Craft	III-D	5*	
		Play Directing for Stage and TV	III-E	5*	
		Drama and The Playwright	III-N	2*	
		Lighting	III-H	5*	
		Advanced Directing	III-E	5*	
		Costume and Make-up	III-D	2*	
		Scenery Design	III-D	2*	
		Film and Television Production	III-J	5*	
		The Film: Technical Aspects and Practical Application	III	5*	
University of Houston, Houston	Radio and TV	Films for TV	III-J		
	Photography	Commercial Photography	III-C	3-3	
		TV Photography	III-J	3-3	
Utah					
Brigham Young University, Provo	Speech and Dramatic Arts	Mass Communications and Society	II	2 to 4	X
		Seminar in Mass Communications	II	2 to 4	X
Washington					
State College of Washington, Pullman	Speech	Introduction to Theater Arts	I-A	3	
University of Washington, Seattle	Radio-TV	Television Film Techniques	III-J	2 or 3	
Wisconsin					
University of Wisconsin, Madison	Education	Local Production of Audio-Visual Materials	III-I	2-3	X

* Course gives undergraduate and/or graduate credit.

It appears that in each of the various production phases, excluding music, the number of courses offered has increased. Roughly, six times as many production courses were offered in 1949 as in 1946, and 11 times as many production courses were offered in 1956 as in 1946. An increased emphasis on the production phases of the motion picture is indicated when production-course totals are compared to the total course offerings listed. Of the 86 courses listed in the 1946 survey, only 19% were production courses; 33% of the 300 courses listed in 1949 were in the production category; while 64% of all the film courses reported in 1956 were of the production type.

The number of institutions offering a sequence of courses leading to a degree in motion pictures has increased little during the past decade, especially when compared to the phenomenal growth of television-course sequences within the past 5 years. Two institutions offered a degree in motion pictures in 1946; four offered a degree in 1949; and eight universities offered at least a Bachelor's degree in motion pictures in 1956. These eight universities, incidentally, offered 61% of the 275 courses found in institutions of higher education in 1956.

An increase in the number of institutions offering a comprehensive complement of courses in motion-picture techniques can be anticipated in the decade ahead. The demand for trained film-production personnel is becoming acute as the result of the rapidly growing market for films in television, industry and business, education and religion. The University Film Producers Association reports that more than 70 colleges and universities in this country operate film-production units. While these units operate, generally, apart from instructional departments, they have turned to the film teaching departments for personnel. Although the films produced by these units vary in quality, they are, nevertheless, worthy of annual recognition by the Screen Producers Guild, and in 1954 and 1955 films from the University of California at Los Angeles and the University of Southern California won short-subject awards from the Academy of Motion Picture Arts and Sciences.

Further, enrollments at the college level will take a sharp upswing in the years immediately ahead and enrollments in motion-picture instruction departments will inevitably increase. This will provide increased funds to enable many institutions to acquire the costly equipment that is necessary to offer a sequence of motion-picture production courses.

The need for competent instructors will soon become desperate and the

growth of the motion-picture industry in all its aspects in the United States may be inhibited unless help is forthcoming. The Society is making significant progress with in-service professional training courses in New York City and Hollywood, and there are occasional rumblings of projected apprentice-training programs within the industry.

The Society is presently sponsoring two courses,* one in Sound Recording and one in Laboratory Practice, at New York University. Three courses are being given on the West Coast. A course in Electrical and Electronic Principles of Sound Recording is being given at the University of California at Los Angeles and a course in Elements of Sound Recording for Motion Pictures is being given at the University of Southern California. A non-credit course is being given in Laboratory Practice and Color Duplication.

Another phase of SMPTE's educational program is its newly formed Projectionists Information Committee. The purpose of this committee is to aid projectionists in the field by keeping them informed of new developments and techniques.

John G. Frayne, Past-President of the Society and Chairman of its National Education Committee, in commenting on progress in the decade since he conducted the first film-instruction survey, writes:

"There is today an even greater need than there was a decade ago for a prospective and well-planned program to insure the continuing supply of competent personnel in all aspects of the motion-picture industry. The tremendous technological advances following the close of World War II are beginning to have an impact on the motion-picture industry, and yet, sad as it is to relate, the motion-picture industry today offers less attraction to trained engineers than it has since the introduction of sound 30 years ago. The result is the continuation of the production methods, cumbersome and costly, which would not be tolerated in other industries which have eagerly sought and obtained the benefits of new advances in electronic arts in order to speed up production and prevent production costs from skyrocketing.

"The courses of instruction given so far through the efforts of the Committee on Education of the SMPTE have, of necessity, been aimed at raising the level of technical training for those already employed in the industry, many of whom are without solid technical education or background to approach the new advances in the electronic arts.

"There has been little or no progress in coordinating technical instruction in our colleges and universities with the needs of the motion-picture industry. This, sadly to relate, is due, in part at least, to the hesitancy of the management of the motion-picture studios to give serious consideration to this problem which affects the very future of the industry. It is high time the management of the studios gave more time and attention to the procurement and training of technical people. An industry as complex as the motion-picture industry cannot continue to rely upon the hiring hall for a supply of engineers and technicians trained in modern electronic theory and practice.

"A golden opportunity exists here in the home of the motion-picture industry for a coordinated program of education and training in connection with two of our outstanding local universities, both of which are attempting without much encouragement from high places to develop the very kind of training programs the industry needs for its survival."

Finally, it is an obvious fact that no craft in the history of civilization has achieved the status of a profession without some rigid and cooperating training program. Neal Keehn put the problem in sharp focus, saying ". . . a good many of the newcomer's fumbling errors can be eliminated or at least reduced by some formal training which is seldom available on the job except on a catch-as-catch-can basis."[7]

Further Research

A study of the professional schools and technical institutes offering motion-picture and television courses is needed. The continuing research in motion-picture and television instruction being carried on by the Society could profitably be coordinated, to prevent overlappings, with such organizations as the American Educational Theater Association, University Film Producers Association, and the several television education groups. And, upon publication of this report, errors and omissions will be detected. To insure completeness and accuracy in the next survey, such errors and omissions should be brought to the attention of the Society's National Education Committee and Chairman John G. Frayne, c/o Westrex Corp., 6601 Romaine St., Hollywood 38.

Acknowledgments

The author wishes to acknowledge the very substantial contributions made to this survey by A. J. Reynertson, President of Alturas Films, Santa Barbara, Calif.; Luella Snyder, Syracuse University; Herbert Farmer, University of Southern California; Gertrude G. Broderick, U.S. Office of Education; and Charles J. Ver Halen, Jr., publisher of *Film & AV World*.

References

1. John G. Frayne, "Report of the Committee on Motion Picture Instruction," *Jour. SMPE*, *47*: 95–106, Aug. 1946.
2. Jack Morrison, "Motion picture instruction in colleges and universities," *Jour. SMPTE*, *55*: 265–278, Sept. 1950.
3. Jack C. Ellis, (unpublished dissertation) *Approaches to Film as an Art Form: A Handbook for College Teachers*. Teachers College, Columbia University, New York, 1955.
4. Buell Whitehill, Jr., "Motion picture instruction, production and research in colleges and universities," *Quarterly J. Speech*, *37*: 203–206, Apr. 1951.
5. Jean Lods, *Professional Training of Film Technicians*, UNESCO, Paris, 1951.
6. Adrian TerLouw, *A Survey of Photography Instruction in Colleges, Universities and Technical Institutes*, Eastman Kodak Co., Rochester, N.Y., 1954.
7. Neal Keehn, *Sixty Years of 16mm Film, 1923–1983*, chapter on "Production," Film Council of America, Evanston, Ill., 1954.

* Information about the courses sponsored by the SMPTE may be obtained from the following: East Coast-Sound Recording: Edgar A. Schuller, Magnetic Recording Dept., De Luxe Laboratories, Inc., 850 Tenth Ave., New York 19; Laboratory Practice: James Kaylor, Movielab Film Laboratories, Inc., 619 West 54 St., New York 19. West Coast-Sound Recording: L. D. Grignon, 1427 Warnell Ave., Los Angeles 24; Laboratory Practice: Sidney P. Solow, Consolidated Film Industries, 959 Seward St., Hollywood 38.

news and reports

Fall Convention October 4–9 Hotel Sheraton, Philadelphia

This Fall's Convention is the first, at least in recent times, to be held over a weekend. It will start on Friday morning and finish on Wednesday. Also, it is the first held in Philadelphia since the Spring of 1919.

Philadelphia has recently been putting all its efforts into a civic rejuvenation process that should make it a noteworthy center for meetings such as ours. Reconstruction in the center of town, including the sleek new Hotel Sheraton, opened only a few months back, where the Convention will take place, and a general refurbishing of the historic areas in which Philadelphia is so rich, should make the new Philadelphia a most attractive spot to bring the family. With this in mind, the inclusion of the weekend will give ample opportunity for the really delightful social program that seems to be shaping up, and for the family sightseeing excursions to the many points of interest in and around the city.

Some of the social units that are already well into the planning stage are a meal at Bookbinders and another at the Cherry Hill Inn. This is in addition to the usual cocktail party and banquet which will be held at the Sheraton. Then there will be conducted tours to local historic sites and to Valley Forge, and visits to the Franklin Institute and the Art Museum.

The committees that have already got busy making all these arrangements will have the following chairmen:

Local Arrangements, *A. J. Platt*
Public Address and Recording, *Everett Miller*
Hotel Arrangements, *H. L. Ewing*
Ladies Committee, *Mrs. A. J. Platt*, *Mrs. Everett Miller* and *Mrs. H. L. Ewing*
Registration, *E. T. Griffith*, *L. W. Leidy* and *Edward Stanko*
Auditors, *Herbert Mattelson* and *George E. Dutch*
Luncheon, *Joe G. Mullen*
Exhibits, *H. R. Henken*
Hospitality and Transportation, *H. L. Ewing*
Entertainment, *A. J. Platt*
Banquet, *Joe G. Mullen*
Projection, *R. H. Heacock*
Publicity, *Hal Rusten*
Administrative Asst. to Convention Vice-President, *R. H. Hooper*

The Convention will open Friday, October 4, with Registration and the first technical session in the mornings followed by the Get-Together Luncheon. There will be another session in the afternoon. High point of the Program will be the Awards Session scheduled for Friday evening. At this session five awards will be presented: Journal Progress Medal Award, Samuel L. Warner Memorial Award, David Sarnoff Gold Medal Award and Herbert T. Kalmus Gold Medal Award. At this session those newly elected as Fellows of the Society will be introduced.

The tentative schedule for Saturday includes morning and afternoon technical sessions and informal entertainment in the evening. Sunday will be set aside for trips to points of local interest and entertainment. Technical sessions will resume on Monday morning and the banquet and dance will be held Monday evening. Tuesday will be devoted to technical sessions, morning, afternoon and evening, and morning and afternoon technical sessions will be held Wednesday.

Technical Papers

As announced in the May and June *Journals*, there is a full-fledged Papers Program planned under the chairmanship of *Dr. Deane R. White*, Photo Products Dept., E. I. du Pont de Nemours & Co., Parlin, N.J.

The rosters and addresses of the 82d Convention Program Topic Chairmen and of the Papers Committee Regional Chairmen are in the two previous *Journals*. Full information, including Author Forms, is available from Dr. White or from the Editor at Society headquarters.

Deadlines for Papers

Before August 1, the Program Chairman, Dr. White, must have received from prospective Program authors: the Author Forms; three copies of a 50- to 75-word abstract, typed double-spaced; and two self-addressed business-size envelopes.

Before August 30, copies of the manuscript and brief biographical information, as described on the Author Forms, are due the Program Chairman, the Editor and Publicity Director.

Due to summertime work on the Program, early cooperation will be especially helpful and will ensure proper scheduling of your papers.

The roster of Engineering and Administration Committee Meetings will be announced later.

Education Courses

A panel session which closed the Sound Recording Course co-sponsored by SMPTE and I.A.T.S.E. Local 52 was held at Fine Studios, 711 5th Ave., New York, on June 12. Examinations for the course were held June 19.

Panel members were: Robert Engler of Westrex; Raymond Griswold of RCA Film Recording; Edwin Dickenson of Westrex; David Blumgart of Information Productions; James Shields of CBS; Nicholas Cook of Public Service Gas & Electric; Richard Pietschmann of Louis de Rochemont — Cinemiracle; Jack Leahy of RCA Film Recording; George Lewin of Army Pictorial Center; Theodore Lawrence, Consultant; Homer Elder of Metropolitan Sound; Christopher Lankester, United Nations; John Maurer of JM Developments; Burt Perry of Westrex; William Jordon of Movietone; and Emil Neroda of Reeves Sound Studios.

The discussion ranged over topics covered in the 20-week course which began on February 6, 1957.

The course in Laboratory Practice which began February 18 closed June 17. Plans are underway for the repetition of these courses early in 1958 and consideration is being given to setting up advanced courses.

Both courses were given in cooperation with New York University and have

The Sound Recording Course Panel. Standing, left to right: Robert Engler, Raymond Griswold, Edwin Dickenson, David Blumgart, James Shields, Nicholas Cook, Richard Pietschmann, Jack Leahy, George Lewin; seated: Theodore Lawrence, Homer Elder, Christopher Lankester, John Maurer, Burt Perry, William Jordan, Emil Neroda.

been outstandingly successful. Quotas for both courses were filled shortly after the announcement was first made and many applicants had to be refused.

The SMPTE educational program passed the experimental stage with the completion in 1956 of three SMPTE-sponsored courses at the University of California and one at the University of Southern California. These courses are being repeated.

One of the most significant aspects of the entire SMPTE educational program is the enthusiastic cooperation given by industry.

Many firms have assisted the Sound Recording Course in various ways. De Luxe Laboratories has offered facilities for committee meetings, screening rooms, duplication of course reference material and equipment for classroom demonstrations. Other firms which have cooperated in offering classroom facilities and equipment include Reeves Sound Studios; Metropolitan Sound Service and Fine Sound.

Assistance in preparation of training aids, reference material, equipment and other facilities was also given by Dichter Sound Studios; Movietone News; RCA Film Recording and RCA Victor Division. Various manufacturing firms supplied recording tapes and reference material: Minnesota Mining and Mfg. Co.; Audio Devices; Reeves Soundcraft; Orradio Industries; Westrex Corp.; Electrovoice; Electrovert; Altec Lansing; Microphone Co.; American Elite; Fairchild Recording Equipment. Reference material and training films were also supplied by 20th Century-Fox and United World Films. Manhattan Trades Center supplied training films and Johnny Victor Theater in RCA Exhibition Hall contributed classroom facilities for three weeks.

Aside from the help with equipment and classroom facilities important cooperation has been given by the firms that have encouraged their key employes to participate in committee activities.

Chairman of the East Coast Subcommittee for Education of Sound Technicians is Edgar Schuller, Sound Recordist for De Luxe Laboratories, Inc., 850 10th Ave., New York. Chairman of the East Coast Subcommittee for Education of Laboratory Technicians is James W. Kaylor, Movielab Color Corp., 619 W. 54 St., New York 19.—*R.H.*

(*An announcement was received at press time stating that the course on Laboratory Practice will be repeated beginning Sept. 26, 1957. Applications may be sent to Mr. Kaylor at SMPTE headquarters. Students will register at New York University.*)

TV in Russia

An impression of the Russian television technician as intelligent, competent, skillful, persevering and adaptable but without a great deal of inventiveness or originality has been conveyed by Axel Jensen, SMPTE Engineering Vice-President, describing his recent trip to Russia.

"There are now about 16 TV stations in Russia: Within the next few years, at a conservative estimate, there will be 60 or 65," Mr. Jensen reports.

Mr. Jensen was in Russia at the invitation of the Popov Society which also invited three other engineers, John N. Dyer, Vice-President of Airborne Instruments Laboratory, Mineola, L.I.; Charles Roualt of General Electric Co.; and Robert Schultz of Sylvania Co. They were invited to visit the television laboratories and installations of Moscow and Leningrad. The group arrived in Russia May 20 and left May 30. A week was spent in Moscow and two days in Leningrad where the Television Institute of Research is located and where most of the TV research is being done.

The emphasis at the Institute is decidedly on color TV. Image-orthicon and super iconoscope tubes are being made having a close resemblance to the RCA model, according to Mr. Jensen.

There is also a great deal of work being done in the field of industrial TV. The equipment and applications are similar to those in use in the United States.

None of the group speaks Russian, so all of the conversations had to be held through an interpreter; however, Mr. Jensen said he had no reason to believe that he did not have full access to everything that was being done in the TV field and the entire trip was not only informative but very pleasant. The Russian engineers had a number of questions for the American delegation and the questions were "good questions — showed real intelligence," Mr. Jensen noted.—*R.H.*

ACL Spring Meeting

The Association of Cinema Laboratories held its spring meeting on May 1, 1957, during the 81st SMPTE Convention at the Shoreham Hotel, Washington, D.C. It was reported that the Association now has a total of 45 active members and 7 associate members.

Two suggestions by Byron received some attention. One was for an information booklet on basic film terminology and methods which could be given to producers as an aid toward education and standardization. Byron agreed to submit a draft of this booklet by early fall. His other suggestion was that the Association arrive at a set of specifications for a printer that would help printer manufacturers design equipment more satisfactory to the membership than any existing printers. Byron agreed to draft a questionnaire to the membership on the subject.

Marshall Rothen of Kenyon & Eckhardt, representing the National Television Film Council, discussed the need for laboratories to adopt standards for television film processing and suggested that producers should also be sold on the importance of maintaining quality and uniformity in the production of such films. Reid H. Ray, President of ACL, said that although the ACL is not a standard-setting body it would ask for guidance from the SMPTE Television Committee, which has given attention to proposals for television film standards, in assembling data and circulating it to film producers, laboratories and broadcasters. Mr. Ray has appointed a committee to consider the problem, and to establish liaison with the SMPTE Television Committee and with the television networks. They are:

Active Members: William E. Gephart, Jr., Chairman, (West); Spencer W. Caldwell (Canada); Louis Feldman (East); Saul Jeffee (East); Garland C. Misener (East); Norwood L. Simmons (West); and Sidney P. Solow (West).

Advisory Committee: Wm. G. Richardson, CBC, Canada; Marshall Rothen, Kenyon & Eckhardt Inc.; T. Gentry Veal, Eastman Kodak Co.; J. R. Whittaker, CBS Television.

Neal Keehn, chairman of the Nomenclature Committee, presented a number of trial definitions of film nomenclature for study and comment.

Further information is available from ACL's Secretary, James A. Barker, c/o Capital Film Laboratories, 1905 Fairview Ave., N.W., Washington 2, D.C.—*D.C.*

Industry, Education News

Hazard E. Reeves, President of Reeves Sound Studios, Inc., Reeves Soundcraft Corp., and Cinerama, Inc., was presented with the Georgia Institute of Technology's Alumni Distinguished Service Award for 1957 at the Institute's Commencement Exercises June 8, 1957.

A Fellow of the Society, Mr. Reeves developed the stereophonic sound system for motion pictures used by Cinerama. His company, Reeves Soundcraft Corp., received an Oscar from the Academy of Motion Picture Arts and Sciences for the development of Magna-Stripe, a process of applying stripes of magnetic oxide to motion-picture film for sound recording and reproduction.

The Citation accompanying the award stated that the recipient had become a "national authority on sound problems" and that his "professional work has brought distinction to your many enterprises and honors to you and your Alma Mater." Mr. Reeves was graduated from Georgia Tech in 1928.

In addition to his membership in the Society, Mr. Reeves is a member of the Academy of Motion Picture Arts and Sciences, the North Carolina Society of New York, the New York Southern Society and other civic organizations.

Boyce Nemec, motion-picture and television consultant, 141 E. 44 St., New York, has been retained by Video Independent Theaters, Inc., to plan studio operations and programming of the telemovie system now being installed in Bartlesville, Okla. (*Journal*, April 1957, p. 227). Mr. Nemec was formerly SMPTE Executive Scretary.

Three wired program channels are expected to be in operation in August. Home subscribers may view feature pictures which run continuously for 8 or 10 hours

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or may turn to a continuous newsreel program. The Bartlesville experiment is being eyed warily by theater owners and exhibitors, the more pessimistic of them regarding it as the death-knell of the motion-picture business.

John Hilliard, Director Advanced Engineering, Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif., has been stationed in Sandia, N.M., for approximately two weeks to direct and supervise the construction of equipment capable of duplicating the actual sound conditions of jet aircraft while in flight. The environmental testing of this high-intensity sound is in connection with Altec's research in this field.

Jay E. Gordon has been appointed Supervisor of a newly established motion picture unit for Autonetics, 9150 E. Imperial Highway, Downey, Calif., a Division of North American Aviation, Inc. Prior to his present appointment, he supervised motion-picture operations of the company's former Missile and Control Equipment organization. He wrote and directed production of *Engineering for Tomorrow*, a detailed study on film of a hypothetical missile's development, which won honors at last year's Cleveland Film Festival.

An earlier film, produced by Mr. Gordon while he was with the U.S. Naval Photographic Center, *Origins of the Motion Picture*, won honors at the Venice and Edinburgh film festivals. He was awarded the Exceptional Civilian Service Medal for his work during World War II in motion-picture production and audio-visual aids.

A member of the Society, Mr. Gordon is also a member of the Edison Pioneers and the Thomas Alva Edison Foundation. He is now Vice-President of the Hollywood Industry Film Producers Assn.

Fred M. Emens has been appointed Sales Manager of the Fastax, High Speed Photography and Photo Instrumentation Division of Wollensak Optical Co., 850 Hudson Ave., Rochester 21, N.Y. A member of the Society, Mr. Emens has been associated with the company for ten years. His experience included administrative activities in the production and industrial engineering and quality control departments.

Richard Youso has also joined Wollensak to serve the Fastax Div. on high-speed photography sales and problems in eastern and midwestern United States. He served for eight years as a group engineer in the Engineering Motion-Picture Dept. of Boeing and was also Photo Chief of Pacific Car and Foundry of Seattle. He was a combat motion-picture cameraman in the European Theater after graduation from the Culver City Motion-Picture Combat School.

Photokina, the International Photo and Cine Exhibition held in Cologne will henceforth be held every second year, beginning with the Fall Exhibition, 1958. Future Photokinas will begin on the last Saturday in September of even-numbered years and will continue for nine days, closing on the Sunday of the week following the opening. Photokina 1958 will be held September 27 to October 5 and Photokina 1960 will begin September 24 and close October 2.

The West Coast Electronic Manufacturers Assn. has given 18 Western universities major scholarship grants in engineering. The grants will provide for a maximum of 32 qualified engineering students during the 1957–58 term. Funds for the Annual WCEMA Scholarship program come from donations made by member companies of the Association. The dean of engineering in each school selects the students to receive the awards, which are given to freshmen and sophomores, or juniors entering from junior colleges. The West Coast Electronic Manufacturers Assn., which has 240 company members located in the major industrial cities of the West, maintains an office at 342 N. LaBrea Ave., Los Angeles and in San Mateo, Calif.

The 4th National Symposium on Reliability and Quality Control, sponsored by IRE, will be held January 6–8, 1958, at the Hotel Statler, Washington, D.C. The Symposium will cover these fields of reliability in the electronics industry: Reliability Organization and Management; Theory and Mathematical Techniques; Design Information; Education and Training for Reliability. A program and detailed information may be obtained from Richard M. Jacobs, Radio Corp. of America, Bldg. 108–2, Moorestown, N.J.

Obituaries

Frank A. Cowan, 59, Assistant Director of Operations for the Long Lines Dept. of American Telephone and Telegraph Co., died June 21 at Lenox Hill Hospital, New York. A distinguished engineer and inventor, he became affiliated with Bell Telephone shortly after being graduated from Georgia Institute of Technology in 1919. He developed varistor-type modulators and demodulators which are widely used in communications systems. He was a Fellow of the American Institute of Electrical Engineers and of the Institute of Radio Engineers. In 1953 he was awarded the Lamme Gold Medal for outstanding contributions to long distance communication and development of transmission equipment. A paper by Mr. Cowan on "Transmission of Color Over Nationwide Television Networks" appeared in the *Journal*, May 1957.

Harold V. King, 49, Sound Recording Director at Associated British Elstree Studios, Boreham Wood, Herts, England, died May 22, 1957, after a long illness.

He became head of the Studios' Sound Department in 1948. His outstanding film credits include such recent successes as *Moby Dick*, *The Dam Busters*, *Its Great to Be Young*, and *The Good Companions*. He made an intensive theoretical and practical study of radio before he entered the film industry as an electrician. He later worked as a camera operator. With the advent of sound, he worked on Alfred Hitchcock's *Blackmail*, the first sound picture to be made in Great Britain. A member of the Society, he was also a member of the British Kinematograph Society and served on a number of its committees and on the Sound Committee of the British Film Producers Association.

Edward Sutherland Rinaldy, 80, a former member of the Society, died May 22, 1957, at the Manhattan General Hospital, New York. His early years were spent traveling with his father who managed a magic show and in 1911 he was employed by the Vitagraph Co. He went into business for himself in 1914, specializing in the development of various types of camera equipment. Among other activities he made special camera adaptations for such explorers as Carl Akely and Martin Johnson.

SMPTE Lapel Pins. Gold and blue enamel reproductions of the Society symbol, with screw back. Available to all members from Society headquarters. Price $4.00 including Federal Tax; in New York City, add 3% sales tax.

section reports

The Atlanta Section met April 1 at the Architectural Building, Georgia Tech Campus, Atlanta, with an attendance of 65. The speaker was Lloyd Thompson, Vice-President of the Calvin Co., Kansas City, Mo. who told of his trip behind the Iron Curtain during May 1956. Mr. Thompson, accompanied by his wife and Mr. and Mrs. Calvin, spent eight days in Russia, spending most of the time in Moscow and Leningrad. Mr. Thompson used a "wide-screen" attachment on his camera and found it surprising that he ran into no censorship difficulties. His talk was illustrated with the Kodachrome transparencies. The visitors found the Russian people to be very friendly and very curious about the Americans.—*Charles W. Wood*, Chairman, c/o Eastman Kodak Co., 4729 Miller Dr., Chamblee, Ga.

The Atlanta Section is batting 1000 weatherwise. Its third meeting was held June 4 at the Architectural Building, Georgia Tech Campus, and for the third time there was a rainstorm on the night of the meeting. Twenty-five members and guests braved the storm to hear Harold Jones of Ansco Co., Binghamton, N.Y., speak on "A New 16mm Color Camera Film for Professional Use," and "Processing Anscochrome Motion-Picture Film for Industrial and Scientific Application." A question and answer period followed his presentation of each topic.—*C. W. Wood*, Chairman, c/o Eastman Kodak Co., 4729 Miller Dr., Chamblee, Ga.

The Chicago Section met May 16 at WNBQ, Merchandise Mart, Chicago, with an attendance of 150. Three papers were presented on the subject of color television. W. C. Prather of the Technical Engineering Staff, WNBQ, Chicago, spoke on "Fundamentals of a Color Television Film System"; T. Gentry Veal, Research Associate, Eastman Kodak Research Laboratories, Rochester, N.Y., spoke on "General Considerations of Lighting for Motion Pictures for Color Television"; and Charles L. Townsend, Manager, Film-Kine Technical Operations, NBC, New York, spoke on "The Factors Involved in the Use of Color Film for Color Television."

In presenting his paper, Mr. Prather outlined, by use of diagrams, the various components which constitute a color TV film chain. After a brief discussion of each of the components which make up a monochrome TV film chain, he discussed the basic terms used in characterizing a color system, such as hue, saturation and brightness. He then presented a brief review of the additive and subtractive systems of color, showing how the basic color TV film chain operates.

Mr. Veal showed, by means of a series of slides, considerations to be taken in lighting a scene of which color motion pictures will be made for transmission over a color

TV system. He discussed the requirements of brightness, contrast and color quality in photographing scenes to make them suitable for TV reproduction. He explained that it was necessary to use both top and back lighting, using back lighting to obtain depth. He showed that the lighting contrast must be held below that used for motion-picture theater reproduction and stressed that the luminous range of the film must be within the range of the TV system for best system results.

In his paper, Mr. Townsend pointed out that it was necessary to have "good" input to a color TV system in order to realize its full capabilities. He used slides to illustrate the system transfer characteristic, hue and saturation. He indicated that it was desirable to avoid controversial colors such as blue-green and yellow-orange. He said that complementary colors produce the best overall results and that it was necessary to consider how the colors would reproduce in a monochrome system to be sure no information was lost.

A question and answer period after the papers was conducted by the speakers and Harold Kinzle, Laboratory Superintendent, Wilding Picture Productions, Inc.

The program concluded with a tour of the facilities of Station WNBQ. As a special demonstration, a color TV receiver was set up so that members and guests could view part of a live color telecast of the Lux Theatre originating in Hollywood.—*H. H. Brauer*, Secretary-Treasurer, c/o Bell & Howell Co., 7100 McCormick Rd., Chicago 45.

At the Chicago Section meeting on June 12 an audience of 125 heard a presentation by two experts of the "why" and "how" of Daylight Saving Time broadcasting. The meeting was held in the main studio of WBKB, American Broadcasting Co.

The first paper, "Clock-Time Broadcasting," was presented by Willaim P. Kusack, Chief Engineer, WBKB. The obvious advantages of clock-time, or DST, broadcasting, whereby the same program is seen at the same local time in each time zone, were touched upon. Chicago has been selected as the control center for DST broadcasting for ABC because of its geographical location and also because the American Telephone and Telegraph transmission facilities are available out of Chicago to the East, West, South and North. From an economic standpoint where transmission costs are based on a cost per mile per hour, Chicago has a definite advantage as a control center, Mr. Kusack said.

He said that their original delay broadcasting operations used film as the recording medium, but that in 1957 three Ampex Video Tape Recorders were installed in the Daily News Building Studio of ABC. Although this equipment has been in use only a short time, it has proved to be a satisfactory means for recording programs for delay broadcasting, Mr. Kusack indicated.

Charles Younger, Engineer-in-Charge of DST Recording and Playback Operations, ABC, Chicago, showed, by means of a closed-circuit TV channel, the physical arrangement of the three Ampex Video Tape Recorders at the Daily News Building Studio. He also showed close-ups of various parts of the recorder and discussed the drive and magnetic recording head construction. He played back videotape recordings of the SMPTE members which were made as the audience assembled for the meeting. He also played back portions of a video recording of the paper and presentation by Mr. Kusack.

A question and answer period followed presentation of the papers.—*H. H. Brauer*, Secretary-Treasurer, c/o Bell & Howell Co. 7100 McCormick Rd., Chicago 45.

The Dallas-Fort Worth Section met May 16 at the Children's Museum, Fort Worth, with an attendance of 37. Speakers were William G. Hassler of the Children's Museum, and Lloyd Thompson, Vice-President of The Calvin Co., Kansas City, Mo. The two speakers described their travels to far different parts of the world. Mr. Hassler told of his expedition through British Guiana to the Amazon in 1937–38 and illustrated his talk with filmed highlights of the trip. Mr. Thompson told of his experiences behind the Iron Curtain during the summer of 1956. His talk was illustrated with color CinemaScope slides.

The Hollywood Section met on April 16 at the M-G-M Studio, Culver City, with an attendance of 185. Douglas Shearer, Director of Research for M-G-M, gave a talk on M-G-M's new method of making

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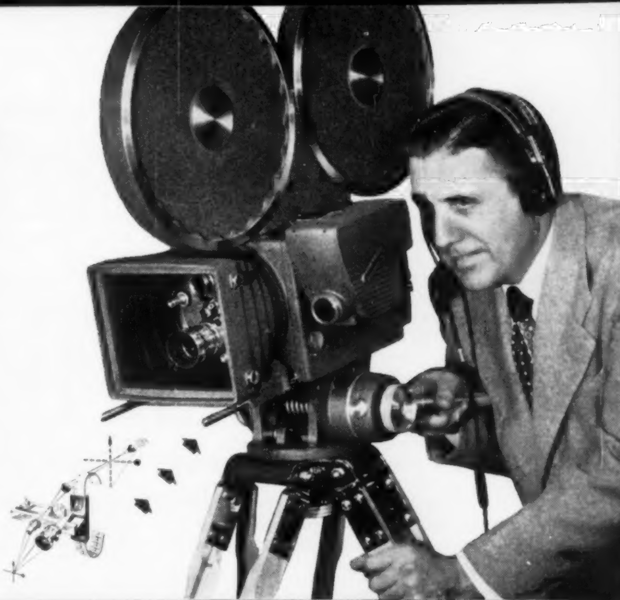
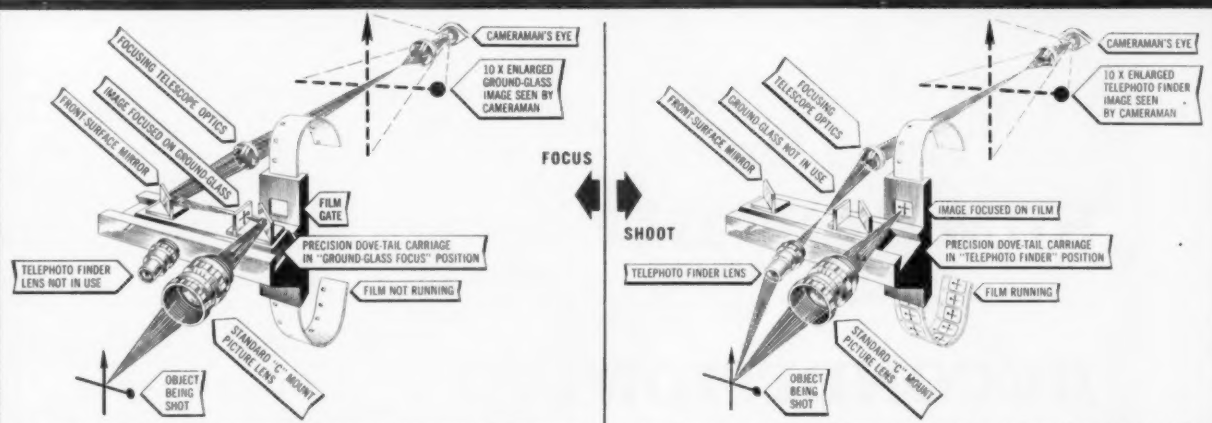


The unique and versatile features built into the 16mm Auricon "SUPER 1200" Sound-On-Film Recording Camera have prompted Producers and Cameramen to name the Super 1200..."Finest 16mm Sound Camera ever built!" This Camera is "Self-Blimped" for whisper-quiet Studio work, has 33 minutes of continuous film capacity, Variable-Shutter or Kinescope "TV-T" Recording Shutter, plus the combined "Rifle-Scope" Telephoto Finder and Reflex-Focusing Optical Systems illustrated below. Its only equal is another Auricon "Super 1200"...



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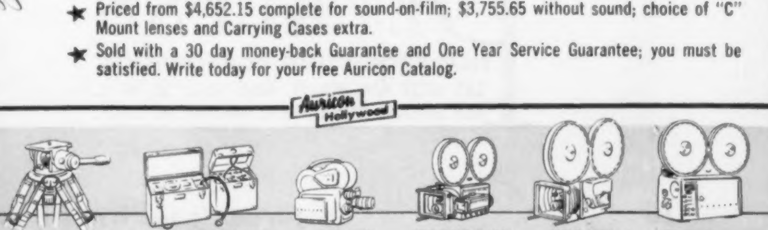

black-and-white wide-screen and CinemaScope motion pictures.

Mr. Shearer explained that standard cylindrical lenses (non-anamorphic) are used in the original photography. The full width of the film between the sprocket holes is used with a mask inserted in the camera to fix the picture height to a 1.85:1 aspect ratio. For the wide-screen, "flat" version, an Academy aperture duplicate negative is made by optical reduction printing using conventional spherical lenses and maintaining the 1.85:1 aspect ratio. For a CinemaScope release the 2:1 anamorphosis is put in in the optical printing of the duplicate negative from which the 35mm release prints are made. The aspect ratio of the CinemaScope version is 2.35:1.

Care is taken in the original photography, with the aid of guide lines on the viewfinder, to compose the picture so as to give a pleasing presentation in either the 1.85:1 or the 2.35:1 aspect ratio. Black-and-white prints made by this method were shown. Mr. Shearer also discussed and showed examples of M-G-M's 65mm color process and outlined the various methods used to obtain 35mm release prints.

A new *f*/1.5 projection light system, employing improved projection lenses and a Bausch & Lomb Balcold heat-transmitting elliptical mirror in the arc illuminating system was described by Walter Beyer of the Motion Picture Research Council. This equipment was on display at the meeting.

An interesting feature of the program was a demonstration by Robert MacDonald of M-G-M's novel portable fog machine. This was a development for which the M-G-M Construction Dept. was recently given an Academy Technical Award.—*Robert G. Hufford*, Secretary-Treasurer, c/o Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

The Hollywood Section met May 21, with 205 attending, at the Cinema Department of the University of Southern California. Dustin Rawlinson, a student in the Graduate School and Chairman of the SMPTE Student Chapter at USC, acted as Master of Ceremonies for the evening.

The meeting opened with the showing of a 16mm color film, *An Occurrence at Owl Creek Bridge*, produced by the USC Cinema Department. Dr. Robert O. Hall, head of the department, gave a short talk on the philosophy of the cinema and this was followed by excerpts from four pictures made by students in the undergraduate and graduate schools. Each picture was introduced by one of the students who had participated in its production. Titles of the pictures and the students who introduced them are: *No Margin for Error*, Douglas Gallez; *The Black Cat*, Villis Lapenieks; *Umbilicus*, Edward S. Seeley, Jr.; and *The Potter*, Michael Jorrin.

Following the showing of the films, Dr. Hall described the academic training and research in the Graduate School. Edward Freed, who directed the Department's Academy Award picture, *The Face of Lincoln*, discussed USC's Farmington Collection of foreign books on motion-picture subjects.

Bernard R. Kantor discussed his work in filming audience reaction by the use of high-speed infrared film and showed examples of this sort of photography. An earlier report by Mr. Kantor appeared in the *Journal* in Nov. 1955.

The meeting was followed by refreshments and a tour of the Cinema Department's production facilities.—*Robert G. Hufford*, Secretary-Treasurer, c/o Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38.

The Rochester Section met April 18 at the Dryden Theater, Eastman House, Rochester, N.Y., with an attendance of 35. John Thorpe, of American Telephone & Telegraph Co., spoke on "Getting the Right TV Program to the Right Station."—*A. E. Neumer*, Secretary-Treasurer, c/o Wollensak Optical Co., 850 Hudson Ave., Rochester 5, N.Y.

The San Francisco Section met May 21 at the Eastman Kodak Processing Plant, Palo Alto, Calif., with an attendance of 64. Paul S. Aex, Asst. Manager of the Palo Alto Plant, gave a brief speech of welcome. Members and guests were taken on a tour of the plant. The tour covered Kodachrome Processing in the 16mm and 35mm size, Kodacolor Processing and Printing, chemical mixing and recovery and quality control.—*Werner H. Ruhl*, Secretary-Treasurer, 415 Molimo Dr., San Francisco.

Membership Certificates (Active and Associate members only). Attractive hand engrossed certificates, suitable for framing for display in offices or homes, may be obtained by writing to Society headquarters, at 55 West 42nd St., New York 36, Price: $2.50.

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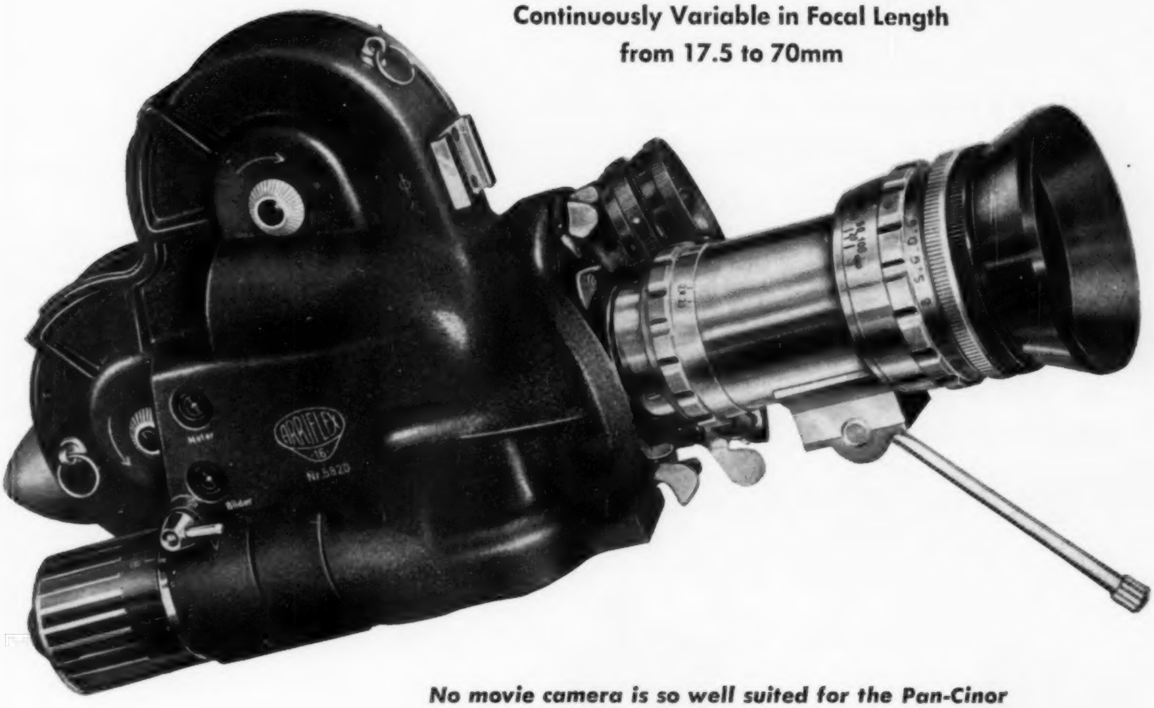

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current literature

The Editors present for convenient reference a list of articles dealing with subjects cognate to motion-picture engineering published in a number of selected journals. Photostatic or microfilm copies of articles in magazines that are available may be obtained from The Library of Congress, Washington, D.C., or from the New York Public Library, New York, N.Y., at prevailing rates.

American Cinematographer vol. 38, Apr. 1957
Photometry in the Film Studio (p. 232) *R. L. Hoult*
Racing Camera Car (p. 234) *W. Carroll*
Dynamic Frame (p. 236) *D. Hill*
Using Strobe Lights for Time-Lapse Cinematography (p. 240) *G. W. Hazen*
Continuous Viewing and Focusing Finder (p. 244) *Z. H. Price*

vol. 38, May 1957
Memomotion Study—New Use for Cinematography (p. 302) *F. Gropper*
Use of Dimmer Banks in Modern Set Lighting (p. 304) *P. Tannura*
Shooting a TV Film Production in Low Key Using Tri-X (p. 308) *G. C. Fenyon*
Laminated Magnetic Tracks for 16mm Films Gaining Favor (p. 310) *J. Henry*
"Taiyo to Bara" Displays Japanese Cinematographic Techniques (p. 312) *F. Foster*
Collection of Vintage Cameras (p. 313)

British Kinematography vol. 30, Mar. 1957
Philips Equipment for Picture Projection and Sound Reproduction of Todd-AO 70mm Film (p. 63) *W. J. M. Jansen*
Suggested Standardizations for Foreign Versions of 16mm Films (p. 75) *J. Seabourne*

vol. 30, Apr. 1957
The Economics of Photographic Washing (p. 95) *G. I. P. Levenson*

vol. 30, May 1957
Depth of Field and Picture Quality with the New Techniques (p. 123) *B. Pollard*
The Use of 16mm Film in Television (p. 129) *N. F. Chapman*

Electronic Engineering vol. 29, May 1957
An Optical Scanning and Recording System for a Photo-Electric Optical Bench (p. 231) *T. N. J. Archard* and *D. H. Rumsey*

Electronics vol. 30, May 1, 1957
Simultaneous Color-TV Test Signal (p. 146) *R. C. Kennedy*
Electronic Shutter for TV Kinescope Recorder (p. 186) *D. C. Crocker*

Institution of Electrical Engineers, Proc.
vol. 104 B, Mar. 1957
A Survey of Factors Limiting the Performance of Magnetic Recording Systems (p. 158) *E. D. Daniel, P. E. Axon,* and *W. T. Frost*

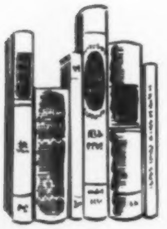
International Projectionist vol. 32, Apr. 1957
Drive-In Projection: A Challenge (p. 7) *R. A. Mitchell*
A Conversion Method for Db and Volume Units (p. 12) *J. Holt*
Is it Going to be Cable Theatre? (p. 13)
NTS's Telemovies Projection Equipment (p. 14) *R. MacLeod*

vol. 32, May 1957
Motion Picture Research Council: An Industry Technical Aid (p. 7) *R. MacLeod*
From the British Viewpoint—Two New Anamorphic Processes and a Stereosound Forum (p. 14) *R. H. Cricks*
Telemural Projector—RCA's Newest Advance (p. 20)
Technirama Process Debuts in Italy (p. 21)

Kino-Technik vol. 11, Feb. 1957
Stand und Entwicklungstendenzen der Tonstudiotechnik (p. 36) *F. Winckel*
Die Nachsynchronisierung von Dreisprachigen Filmen (p. 39) *W. Straub*
Die Anwendung von Transistoren in der Studiotechnik (p. 42) *H. G. Pühler*
Studio-Zweibandprojektor 16/16 mit Synchronmotor (p. 45) *H. Kronenberger*

vol. 11, Mar. 1957
Ein Programm und ein Werk im Zeichen "Arri" (p. 72)
Eugen Bauer GmbH: Neue Wege fur den Tonschmalfilm (p. 74)
Bell & Howell—Geräte mit Letzter Präzision (p. 76)
Schmalfilmindustrie mit Unternehmungsgeist (p. 78)
Projektoren der Microtecnica in Turin (p. 86)
Eumig-Wien: Produktion mit Tradition (p. 88)
Paillard—Schweizer Schmalfilm-Präzision

vol. 11, Apr. 1957
Ein Rundgang durch die Technischen Anlagen Duetscher Fernseh-Studios (p. 120)
Fernsehübertragung mit der Zeiss Ikon-Telekino-Anlage (p. 138)
Ein Fahrbares Studio für Fernseh-Übertragungen (p. 142)



books reviewed

Handbook of Electronic Measurements

Edited by Moe Wind. Published by Polytechnic Institute of Brooklyn, Microwave Research Inst., 55 Johnson St., Brooklyn 1, N.Y. 2 vols. 929 pages total. Price $15.00 per set.

This two-volume book was written to fill the important requirement for an up-to-date reference, including a bibliography of sources, in the field of electronic measurements. The material is divided into 18 chapters, each written by a well-known authority on the particular topic. The authors of the various chapters have gone to considerable trouble to maintain reasonable continuity of style throughout the book, with gratifying results. Although methods of approach to measurements differ in various chapters, the volumes suffer far less than most from the discontinuity caused by a number of authors.

Each chapter covers the methods of measurement of a specific quantity, starting with d-c and proceeding upwards in frequency to the microwave region. The chapters cover measurement of voltage and current, power, impedance, frequency and wavelength, time interval, phase, field intensity and radiation, bandwidth, gain, noise figure, transients, distortion, waveforms, stability, modulation, spectra, and attenuation. Special attention is paid in each case to the various sources of error in measurement, and for each of these, a complete explanation is given together with discussion of the order of magnitude and methods of compensation. In addition, a comprehensive theoretical treatment has been included wherever it seemed necessary and desirable.

One excellent feature is the first chapter, which provides an historical background and an introduction to the problem of electronic measurements. In this chapter are also to be found the definitions of the various units and a comprehensive and concise review of the fundamentals of electromagnetic theory, with emphasis placed on the application to measurements.

In general, the information is presented in a convenient form, and representative equipment necessary to make each of the measurements is discussed in some detail. Although, as might be expected, no material on measurements other than those in electronics is presented, much of the material on measurements at audio frequencies is of interest in the field of acoustics and related fields.

Engineers in both the motion-picture and television fields should find the book useful both as a reference and as an index to further sources of more detailed information on specific equipment and measurements. For those who have only an occasional need for information, and those who wish to acquire a fairly extensive background in this field, the book would be an excellent text for study. Each chapter is complete in itself, thus facilitating study of a particular measurement, while the book as a whole presents a comprehensive, detailed, and easy-to-understand picture of the field of electronic measurements.—*Harvey W. Mertz*, Philco Corp., 22nd St. & Lehigh Ave., Philadelphia 32.

The Handling, Repair and Storage of 16mm and 8mm Films is a new Eastman Kodak Co. publication of 12 pp. which gives instructions on how to extend the useful life of movie films. It is especially useful for schools, libraries and other users of audio-visual materials. Sections cover possible causes of damage to films and suggestions for inspection, repair and storage. The booklet is available without charge from the Sales Service Division, Eastman Kodak Co., Rochester 4, N.Y.

Also available without charge is a one-page reprint, "Anyone Interested in Higher Speed Color Film?" which explains how to obtain a speed increase of one full stop in Ektachrome Films using the E-2 process.

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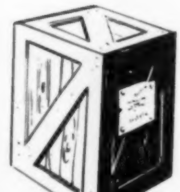

new products (and developments)

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

The Macbeth-Ansco Electronic Densitometer, Model 12A, has been announced by the Macbeth Instrument Corp., P.O. Box 950, Newburgh, N.Y. Features of the new model include direct reading in linear density scale, 0 to 4.0 in color and black-and-white; electronic zeroing; separate zero adjustments for each color filter and a dynode feeding photomultiplier tube circuit for stability and sensitivity. It is priced at $985.00 for the basic unit. A reflection head attachment is priced at $195.00.

The Wollensak Optical Co., Rochester, N.Y., has announced three new products: a Fastax High-Speed motion-picture and oscillographic camera, a 16mm Motion-Picture Analysis Projector and a Fastair motion-picture Missile Camera (shown above).

The Fastax-WF-17 combination high-speed motion-picture and oscillographic camera was designed to record both mechanical and electrical data on the same film, to be used especially where studies of short duration are required. It has speed ranges from 150 to 8000 pictures/sec and can be used for either picture or oscillographic recording independently. Its cost is from $2250.

The 16mm Motion-Picture Analysis Projector was developed for the study and analysis of subjects filmed by high-speed motion-picture cameras. A special feature of the projector allows the film to be advanced frame by frame at the projector or remotely at the screen. Prices range from $510 up depending on accessories required.

The missile camera is constructed to withstand extremely high "G" loads, severe vibration, impact and shock and will accept 50- and 100-ft daylight loading magazines. It incorporates the revolving prism principle. It is priced at $1295.

Bell & Howell, 7100 McCormick Rd., Chicago 45, has introduced a 2-time telephoto attachment for Bell & Howell 20mm lenses which fits the 16mm electric-eye motion-picture camera and the Sunomatic lenses on the 200 series, without affecting the automatic exposure features of these cameras. It complements the wide-angle attachment introduced late in 1956. By doubling the focal length of the camera lens, the attachment in effect brings the subject closer to the camera. It is available from Bell & Howell dealers at a suggested retail price of $89.95. A matching 40mm viewfinder objective is available at $10.50.

Sylvania Electric Products Inc., 1740 Broadway, New York 19, introduced a new model of its RF (Radio Frequency) lamp for color motion-picture printers at the SMPTE 81st Convention Exhibits. The new lamp is reported to have a life expectancy of 500 hours as compared to 100 hours for the original RF model. Although the new lamp has not been changed externally from the original lamp introduced in January 1956, the improvements include a change in the diameter of the refractory disc, from $\frac{5}{16}$ in. to $\frac{3}{8}$ in., thereby bringing it into accordance with the international standard light source, and a change in the operating temperature from 3100 K to 3500 K. The earlier developments were described at the Society's Convention at Lake Placid in Oct. 1955 and in the *Journal* in Dec. 1955.

The Magnetic Sound Striping Co., 1472 Broadway, New York 36, has been appointed by the Minnesota Mining and Mfg. Co. as striping laboratory for amateur and professional motion-picture film. Company officials have announced that magnetic sound striping can be added within 48 hours of receipt of unstriped film.

An experimental silicon power transistor, capable of providing an output of 5 w at 10 mc either as an oscillator or an amplifier, has been developed at Bell Telephone Laboratories under the sponsorship of the Joint Services. Unilateral gain is in excess of 20 db, and a collector efficiency of better than 40% has been achieved.

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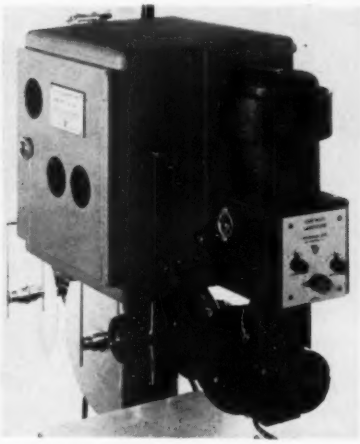
The Perkin-Elmer Corp., Norwalk, Conn., has issued a 12-page brochure describing its optical tracking instruments and systems. Specifications are given for such systems as the Recording Optical Tracking Instruments for long-range photography of missiles in flight; Telescopic Photographic Recorder, a mobile photographic recording system and the Kth 55 Cine-Theodolite, for tracking missiles and airborne objects at short and intermediate ranges.

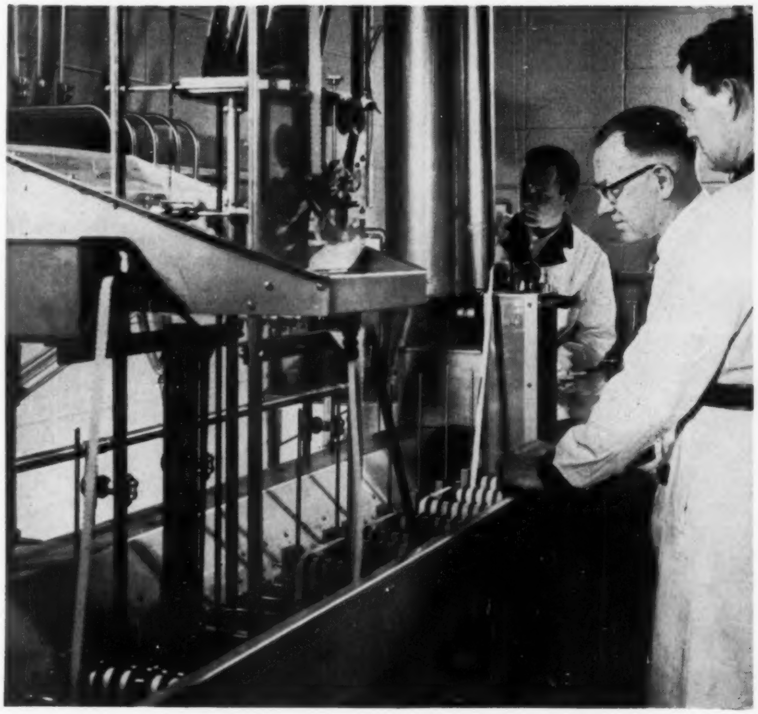


The Fish-Schurman Corp., 70 Portman Rd., New Rochelle, N.Y., has announced its Hi-Speed Additive Color Compensating Head for continuous printing at 200 ft/min. It was originally designed to operate with the Bell & Howell Model E and is now available to fit D and J heads. Designed with a single 1000-w light source, adjustable in complete darkness in all directions by knob setting and three electromechanically operated light valves, this machine is said to provide color changes in 5 msec. Each light valve is controlled by five small solenoids to provide 32 printer steps. The light valve opening may be adjusted for color stock changes without altering the 32-step arrangement.

Light efficiency is obtained by using six interference multilayer, all-dielectric beam splitters and by eliminating absorbing trimming filters. Separation of the color bands is accomplished without overlap and with little light loss. The machine is priced at $8,500 F.O.B. New Rochelle, N.Y.

A 5-channel punched-tape reader, with memory system, reading in succession red, green, blue, blank, is also available for actuating the three light valves and priced at $3,200. A punch coder with counter for programming 5-channel tape reader is priced at $2,400.

The Harwald Co., 1216 Chicago Ave., Evanston, Ill., has taken over the manufacture and distribution of the Movie-Mite 16mm sound projector from The Calvin Co., Kansas City, Mo. The Movie-Mite was recently re-engineered and now includes such features as a curved film gate, single lamp for both sound and picture, and automatic safety trips which stop the machine automatically if a loop is lost. The projector weighs 28 lb and is suitable for classroom use as well as for industrial applications. It is priced at $298.50.



The Geo. W. Colburn Laboratory, Inc., 164 N. Wacker Dr., Chicago 6, announces completion of the installation of a new color processing machine, built by the E.D.L. Company of Gary, Ind., to process both internegative and release prints in the amount of over 40,000 ft a day.

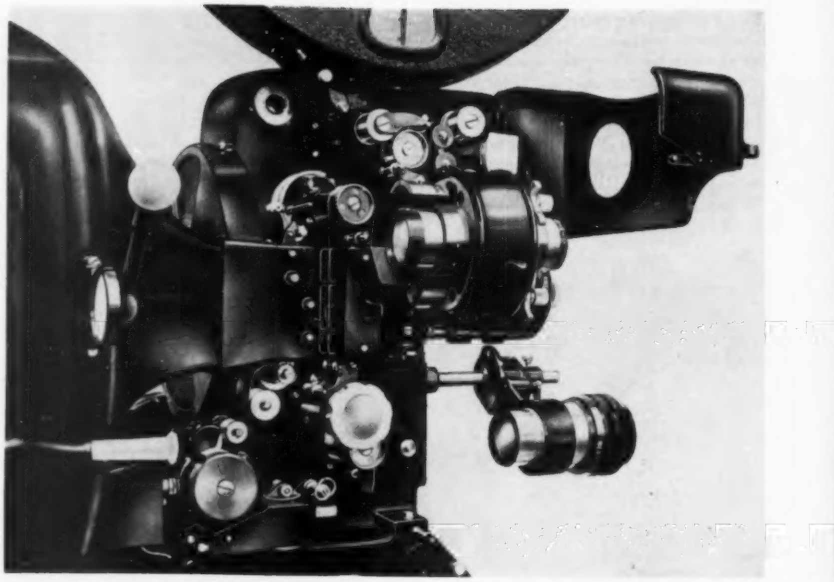
The Colburn Laboratory also announces

a new method of printing 16mm color prints in quantity without risk of damage to the original film. The printer, designed by the company's president, Geo. W. Colburn, prints the internegative from A & B originals, incorporating fades, dissolves and the invisible splice editing techniques. The printer also is capable of adjusting color balance for individual scenes. The new method is reported to produce prints of notably better quality than are obtained from the color-reversal method.

Magnasync Mfg. Co., Ltd., 5546 Satsuma Ave., N. Hollywood 2, has announced the appointment of Kine Engineers, 17 New Queen's Rd., Bombay, India, as exclusive agent for the sale of Magnasync products in India. The West Coast company manufactures magnetic film recording equipment.

R. C. Merchant & Co., 18411 W. Nicholas, Detroit, has been appointed sales representative for Reeves Soundcraft Corp. in the State of Michigan. The company will handle the complete Soundcraft product line of magnetic tapes and other items.

The Compco Corp., 2251 W. St. Paul St., Chicago, has announced the appointment of Motion Picture Enterprises, Inc., Tarrytown, N.Y., as its exclusive East Coast Sales Representative for the film reels and cans manufactured by the Chicago company.



The Fedi XII T Projector, which was briefly announced in the New Products columns of the April 1957 *Journal*, is a redesigned version of the Fedi XII S Projector (p. 530 of the Sept. 1956 *Journal*), manufactured by Ing. Angiolo Fedi S.A., 6 Via S. Gregorio, Milan, Italy. In making this revision, the three principal design objectives were: to permit operation with 100–125-amp high-intensity arc lamps without overheating the film; to permit change of projection ratio without stopping the projector and without changing the aperture plate; and to permit switching projection lenses and re-establishing focus without stopping the machine.

With an arc lamp producing the 30,000 lm necessary to illuminate a 150-sq m screen, the film is subjected to a temperature of 600 C. In the Fedi XII T, cooling is achieved by water circulation, and heat-absorbing filters which are mounted on a two-bladed shutter; the rotation of this shutter (1400 rpm) cools the filters. It is claimed that the 600 C temperature can be reduced to 350 C by this means.

The turret lens holder takes three lenses of different focal length for 1.37:1 standard, 1.66:1 VistaVision, or 2.55:1 CinemaScope ratios. Each lens can be focused independently by means of a micrometric device and a rotation of 120° is sufficient to bring into the optical axis a projection lens with prechosen focal length, fully prefocused. This can be done while the machine is running. The adjustable aperture plate is composed of four light-cutting edges positioned close to the film plane, adjustable both vertically and horizontally.

Expansion of Photo Research Corp. 837 N. Cahuenga Blvd., Los Angeles 38, has been announced by the firm's President, Karl Freund. The firm, which now specializes in the production of electronically operated ultra-precision instruments for measurement of illumination intensity and color temperature, is enlarging its research facilities for electronic instruments in the television field. Dr. Freund has also announced that N. H. Bensussen will be Vice-President in charge of production; Frank F. Crandell, Vice-President in charge of research; and Romauld Anthony, General Manager. In making the announcement, Dr. Freund, who is a veteran motion-picture and TV photography director and an inventor of light measurement instruments, predicted rapid growth in television and related image-transmission areas of electronics.

The Moleflector is a product of the Mole-Richardson Co., 937 N. Sycamore Ave., Hollywood 38. Constructed of exterior plywood in a pine frame, it has a 43 sq in. silver reflector, bright on one side and diffused on the other. It is 4 ft square, 1 in. thick and weighs 18 lb. The 28-lb, steel-tubing pedestal has a low of 60 in. and a high of 96 in. The distance from pedestal top to reflector center is 29 in. and the extension leg measures 18 in. Other new items are described on a catalog sheet now available from the company.

The Jerrold Electronics Corp., 23d and Chestnut Sts., Philadelphia 3, has announced a high-speed, electronically operated coaxial switch that reportedly transforms an ordinary oscilloscope into an instrument that takes accurate quantitative measurements. It provides the simultaneous display of two channels or voltages. It is used in conjunction with a standard sweep generator and oscilloscope display. The unit uses two Clare "Mercury-Wetted" switch elements mounted in a coaxial circuit. The switching unit has a maximum current rating of 5 amp at 500 v and can be supplied for either 50 or 75 ohms with a V.S.W.R. of less than 1.08 from 0 to 250 mc. The switching functions are controllable by circuitry at a 30-, 15- or 10-cps rate, locked with the 60-cycle line. A phase reverse switch and a phasing control are provided for adjusting the phase in respect to the line. The switch is priced at $200.

The Minnesota Mining and Manufacturing Co. 78,000 sq ft magnetic recording tape plant at Hutchinson, Minn., which was opened in May, is reported to be the largest in the world. The plant produces magnetic tape for video recording, computers, instrumentation and guided missile work, geophysical exploration and automation as well as for professional and home recording. All of the manufacturing processes leading to the finished tape take place within the plant except for the preparation of the magnetic oxide which is produced in a plant maintained by the firm at Hastings, Minn. The company's headquarters is at St. Paul, Minn., and it also maintains magnetic tape plants in England and France.

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Motion-Picture and Television Production. Twenty years experience in film and 9 years in television, in all phases of work. Desires position with active organization in motion-picture or television production. Not afraid of hard work, heavy responsibility or any problem that may come up in the industry. Available immediately. Write to: Apartment 601, 137 West 45 St., New York, N.Y., Tel: JUdson 2-2257, Ext. 601

Motion Picture Photographer. Presently employed with network affiliated television station as news photographer. Organizational ability, experienced in editing, news writing. Present position includes filming commercials and sales presentations, video slides, advertising and promotional stills. Interested in quality creative production. D. David Bash, 724½ Ostend Court, San Diego 8, Calif.

Recording Engineer. Eight years experience in all phases of motion-picture sound recording including operation (as recordist and mixer), research, design and development work, transmission, maintenance and installation. Former assistant to chief recording engineer of major east coast studio. Will relocate. Box 26, Oakland Gardens Station, Flushing, N.Y.

Producer-Director-Cinematographer. Comprehensive background in all phases of motion-picture production: creative, technical and artistic. More than 13 years in motion-picture, live-television and radio production. Independent producer 6 years. Experience also includes writing, editing, acting and narration. Very fluent Spanish including technical terms. Desires posi-

tion with production company or in motion-picture department of large industrial corporation. Interested in the United States, Central or South America. Résumé available in English or Spanish. Write: Oliver E. Cain, P.O. Box 1594, Amarillo, Texas.

Film Writer-Editor, with directorial experience, now engaged in post-graduate work at City College Institute of Film Techniques. Three years experience in direction of off-Broadway theater. Has written scripts for NBC-TV and industrial films. Experienced with all 16mm cameras and editing equipment. Formerly with Screen Gems, Inc. Willing to relocate. Write: Lawrence G. Cohen, 55 Nagle Ave., New York 40.

Summer Job. Third-year student in Photographic Science, Rochester Inst. of Technology. Secy-Treas. SMPTE Student Chapter. Interested primarily in color control and processing, studied color and black-and-white sensitometry, color printing and color studio, photographic technical analysis. Desires lab work during summer in New York City; available June 3. Write: Stan Feigenbaum, 140 Spring St., Rochester 8, N.Y.

TV Technician. Young man, 27, mechanically inclined, single (but engaged), looking for a TV job with a future. Recent graduate of TV Workshop (finished in top three of class), thoroughly qualified dolly operator, boom operator, audio engineer, TV cameraman, floor manager, video operator, lighting (both as director and grip), and technical direction. Operate film camera and projector and know film processing and editing. Thorough knowledge of remote operations and theory and operation of microwave transmission. Knowledge of color TV principles and operations, scenery and special effects. Intend to secure 1st class license from FCC as radio-telephone operator. Arthur K. Hirshman, 2242 Bragg St., Brooklyn 29, N.Y. NIghtingale 6-3997.

Scientific Film Production. Producer with 12 years experience in production of medical training films and 13 years in still and motion-picture documentation of scientific research material seeks opportunity in studio specializing in scientific, research or educational motion pictures. Four Venice awards, including first prize for best natural science film in 1952. Fellow of the Royal Photographic Society. Wilbour Chace Lown, 306 West 11 St., New York 14. ALgonquin 5-8228.

Recording Director for Slide Films. Thorough knowledge available talent and recording techniques. R. Goldhurst, 913 Second Ave., New York, N.Y. PLaza 9-7654.

Motion-Picture Cameraman-Technician. Age 40, single with car, free to travel. 15 years experience in cinematography, B & W and color, including animation, titling and special effects. Thorough knowledge of 16mm and 35mm production equipment. Capable editor, experienced in laboratory developing, sensitometric control and printing. Commercial and college-unit production experience. B.A. degree; graduate of New Institute for Film and TV, New York. Active member SMPTE. Seeks position with commercial film producer, college unit, or internal industrial film group. References, complete resume on request. Joseph MacDonald, 2414 Sullivant Ave., Columbus 4, Ohio. Tel: BR 6-2053.

TV Stage Manager. NYU graduate, worked with active motion-picture, TV and stage groups, presently employed as cameraman with Artists Enterprises, seeking position as program assistant or stage manager for TV studio. Resume on request. Write: Reg Gamar, 279 92 St., Brooklyn 9, N.Y.

Film Writer-Director now heading film unit large national organization. Administrative experience. Interested in connection with business film producer, film laboratory service department or industrial photo unit. Thorough knowledge all phases of film production including TV spots, animation techniques, public relations, sales and training films. Write: Film Director, 4410 Walsh St., Chevy Chase 15, Md.

Engineering and Technical Film Producer. Background in all phases of technological and industrial film production including direction, camera, editing, business management; presently and for many years producer with own company. Now seeking position that will allow concentration exclusively on production of technological films either with production company or large industrial corporation, preferably in the western states. J. K. P., 4003 Cumberland Ave., Hollywood 27, Calif.

Positions Available

Motion-Picture Development Engineer. Mechanical engineer or equivalent required by long-established motion-picture developing concern. Must be thoroughly familiar with machine design and construction and capable of supervising projects through manufacturing processes. Technical knowledge of color and spray processes desirable. Salary open. Send resume with references and salary requirements to: Filmline Corp., 43 Erna Ave., Milford, Conn.

Film Inspectors. Permanent or summer positions open. Telephone or write: Kern Moyse, Peerless Film Processing Corp., 165 W. 46 St., New York 36.

Motion-Picture Sound Technicians. US. Naval Photographic Center, Anacostia, D.C., has following three positions open. Interested persons should send their qualifications to the Industrial Relations Officer. **Electronics Technician (Sound), GS-9,** salary $5440 per year. Duties as assistant to Transmission Engineer in the maintenance of motion-picture recording equipment. Applicants must have had at least five years of progressive experience in the production of sound recordings or maintenance of sound equipment, which must include two years of specialized experience in sound recording for motion pictures.

Electronics Technician (Sound), GS-9, salary $5440 per year. Duties as mixer and recordist in motion-picture production. Applicants must have had at least five years of progressive experience in the production of sound recordings or maintenance of sound equipment, which must include two years of specialized experience in sound recording for motion pictures.

Electronics Technician (Sound), GS-7, salary $4525 per year. Duties as recordist in motion-picture production. Applicants must have had at least four years of progressive experience in the production of sound recordings or maintenance of sound equipment, which must include one year of specialized experience in sound recording for motion pictures.

Motion-Picture Equipment Maintenance Men. Experience on 35mm Cameras helpful, but not absolutely essential. Our shop has openings for skilled machinists in 35mm projectors, arclamps generators, rectifiers, printers, processors, Moviolas, etc. Write fully to William Allen, S.O.S. Cinema Supply Corp., 602 West 52 St., New York 19.

Junior Advertising Executive. Opportunity for advancement in leading motion-picture equipment firm covering every phase of theatre, film production, cutting room, laboratory and television station apparatus. Interesting work with good future. Write Mitchell Radin, S.O.S. Cinema Supply Corp., 602 West 52 St., New York 19.

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News Columns

Advertisers

Meeting Calendar

Western Electronic Show and Convention, Aug. 20–23, Cow Palace, San Francisco. The technical program will offer 255 papers at 48 sessions.

Biological Photographic Association, Aug. 27–30, Kahler Hotel, Rochester, Minn.

I.R.E.-A.I.E.E. Magnetic Amplifiers Conference, Sept. 4–6, Penn Sheraton Hotel, Pittsburgh, Pa.

American Physical Society, Regional Meeting, Sept. 5–7, Boulder, Colo.

American Chemical Society, National Meeting Sept. 8–13 New York.

American Institute of Chemical Engineers, Regional Meeting, Sept. 15–18, Lord Baltimore Hotel, Baltimore, Md.

Illuminating Engineering Society, National Technical Conference, Sept. 9–13, Biltmore Hotel, Atlanta, Ga.

Instrument Society of America 12th Annual Instrument-Automation, Conference and Exhibit, Sept. 9–13, Auditorium, Cleveland, Ohio.

Society of Photographic Scientists and Engineers, Annual Technical Conference, Sept. 9–13, Hotel Berkeley-Carteret, Asbury Park, N. J.

American Statistical Association, Annual Meeting of Section on Physical and Engineering Sciences, Sept. 10–13, Atlantic City, N. J.

American Institute of Chemical Engineers, Regional Meeting, Sept. 15–18, Lord Baltimore Hotel, Baltimore, Md.

American Society of Mechanical Engineers, Fall Meeting, Sept. 23–25, Statler Hotel, Hartford, Conn.

Standards Engineers Society, 6th Annual Convention, Sept. 23–25, Commodore Hotel, New York.

Institute of Radio Engineers and American Institute of Electrical Engineers, Industrial Electronics Conference, Sept. 24–25, Morrison Hotel, Chicago.

82nd Semiannual Convention of the SMPTE, Oct. 4–9, Sheraton Hotel, Philadelphia.

National Electronics Conference, Oct. 7–9, Hotel Sherman, Chicago.

American Insttiute of Electrical Engineers, Reliability and Quality Control in Electronics, Oct. 10, Silver Spring Md.

American Society of Civil Engineers, National Convention Oct. 14–18, Statler Hotel, New York.

Institute of Radio Engineers, Canadian Convention, Oct. 16–18, Toronto, Ont., Canada.

Acoustical Society of America, National Meeting, Oct. 24–26, Univ. of Michigan, Ann Arbor, Mich.

American Standards Association, Eighth National Conference on Standards, Nov. 13–15, San Francisco.

83rd Semiannual Convention of the SMPTE, including Equipment Exhibit, April 21–26, 1958, Ambassador Hotel, Los Angeles.

84th Semiannual Convention of the SMPTE, Oct. 20–24, 1958, Sheraton-Cadillac, Detroit.

American Standards Association, Ninth National Conference on Standards, Nov. 18–20, 1958, Hotel Roosevelt, New York.

85th Semiannual Convention of the SMPTE, including International Equipment Exhibit, May 4–8, 1959, Fontainebleau, Miami Beach.

86th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 5–9, 1959, Statler, New York.

87th Semiannual Convention of the SMPTE, May 1–7, 1960, Ambassador Hotel, Los Angeles.

88th Semiannual Convention of the SMPTE, Fall, 1960, Shoreham Hotel, Washington, D. C.

89th Semiannual Convention of the SMPTE, Spring, 1961, Royal York, Toronto

90th Semiannual Convention of the SMPTE, Oct. 15–20, 1961, Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1957 Journal.

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of the Society of Motion Picture and Television Engineers

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